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4. The Ordos Desert of Inner Mongolia. By George B. Cressey.... 155

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THE ORDOS DESERT OF INNER MONGOLIA

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GEORGE B. CRESSEY

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1. INTRODUCTION

This study is the outgrowth of two summers spent in the Ordos and of two other seasons in Outer Mongolia during the writer's residence in China from 1923 to 1929. Travel in these remote and desolate regions is always difficult, but has become especially so during recent years on account of bandits. The Mongols themselves are peaceful and friendly, but the desert borderlands through which one must pass have become infested with disorganized soldiers and brigands. On his second expedition to the Ordos, in 1928, the writer was provided with an escort of

36 cavalrymen for the trip through this troubled marginal zone, but the appearance of 200 mounted bandits made it necessary to turn back. A similar near-encounter in 1924 delayed travel for two weeks until a sufficiently large body of soldiers arrived.

For assistance in travel and in the organization of the material, the writer is indebted to many persons and organizations: the Chinese government and especially the Post Office; the University of Shanghai and certain of its students; the faculty of Clark University and particularly Professor W. Elmer Ekblaw. To all of these, and to the many companions of the open road—Lama pilgrims, soldiers, camel pullers, muleteers and boatmen, herdsmen, and fellow travellers—with whom the writer journeyed for an hour or a month, sincere appreciation is given.

2. THE ORDOS; A STUDY IN MAN'S ADJUSTMENT TO ARIDITY

Inner Asia includes a vast region of arid desert and semi-arid steppe (Fig. 1). In Mongolia and Sinkiang there are a million square miles where the rainfall averages less than fifteen inches. In this waste all of life struggles incessantly against the restrictions imposed by the climate and only those plants or animals survive which can adjust themselves to the meagre resources available. The limited water supply furnishes the clue to the interpretation of drainage, vegetation and human activity. Grass is the one resource available to man. The Mongols, in adjusting themselves to its distribution have of necessity become shepherds, wandering from place to place with their flocks in search of pasturage.

The Ordos Desert (Plate II) is an isolated portion of Mongolia which lies just north of the Great Wall of China, nearly enclosed within the arms of the Hwang Ho as it swings northward into Mongolia. The area of the Ordos in some 50,000 square miles, or nearly that of New England. On two sides the desert is bordered by rugged mountains and on the others by loess hills. The central portion is extremely desolate (Figs. 2 and 3). Numerous areas of a thousand square miles or more have never been crossed by a white man, and no Chinese or Mongolian descriptions are available (*1*). These desolate sections are known to the Mongols as the Boro tohoi, or gray plains.

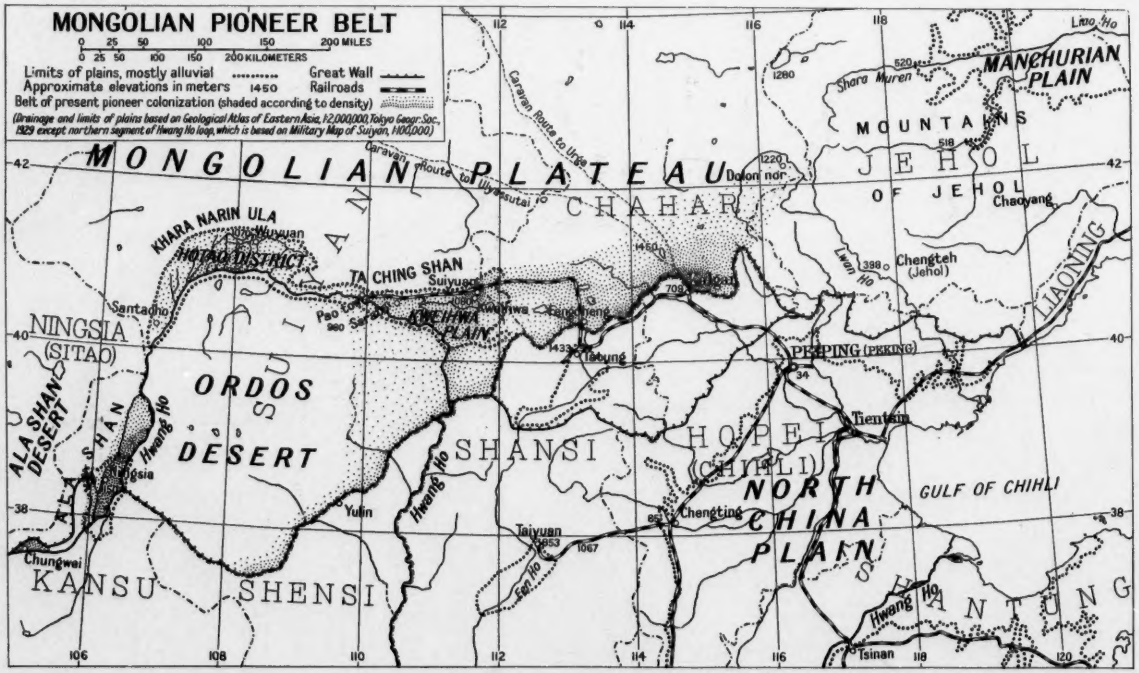
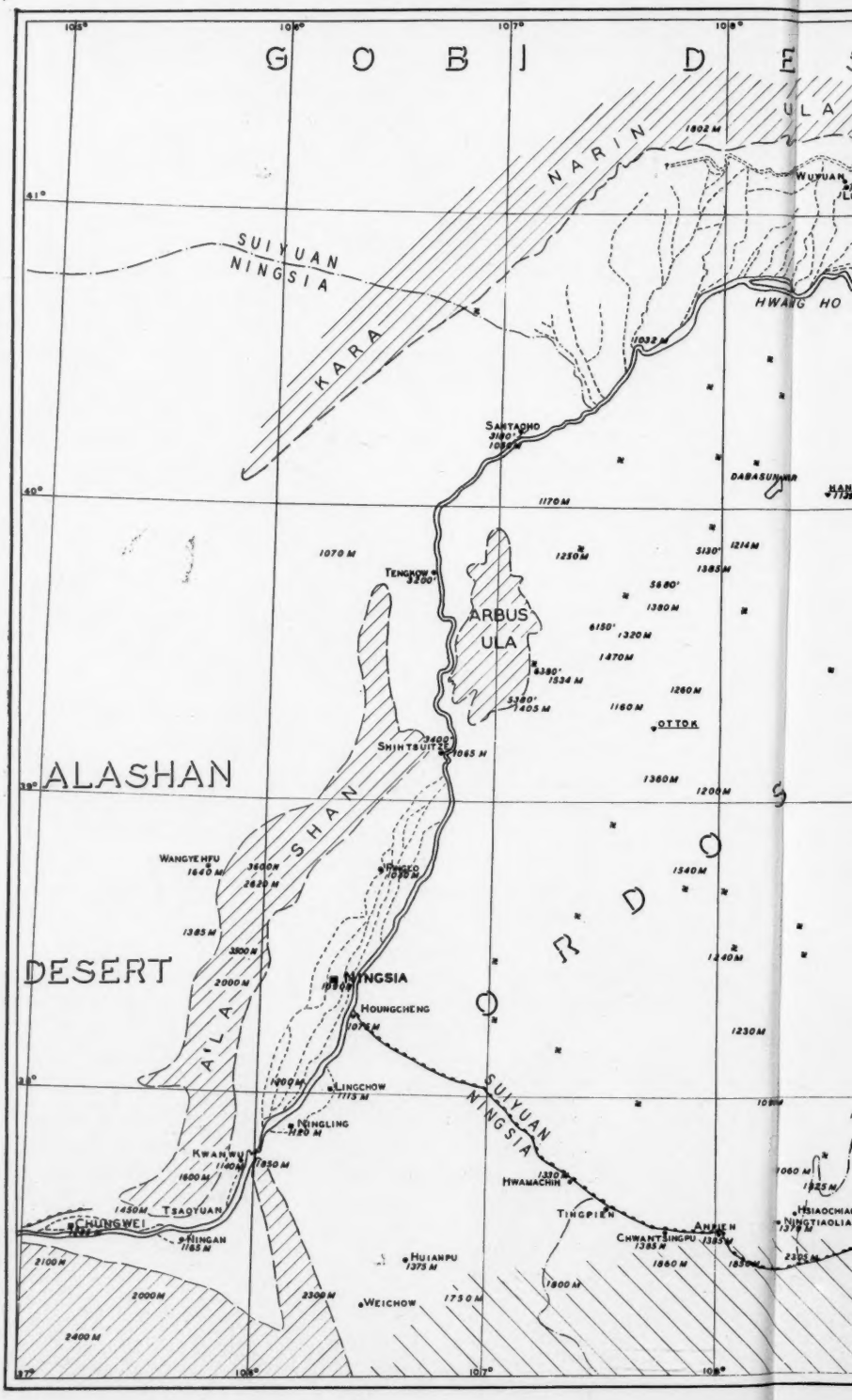


FIG. 1. MONGOLIAN PIONEER BELT

The fringe of present colonization by the Chinese is indicated by stippling, shaded according to density of settlement. (After Cressey, George B. "Chinese Colonization in Mongolia: a General Survey;" *Pioneer Settlement, Special Publication 14*, Amer. Geog. Soc. (1932).) Plate furnished through the courtesy of the American Geographical Society.

THE ORDOS DESERT



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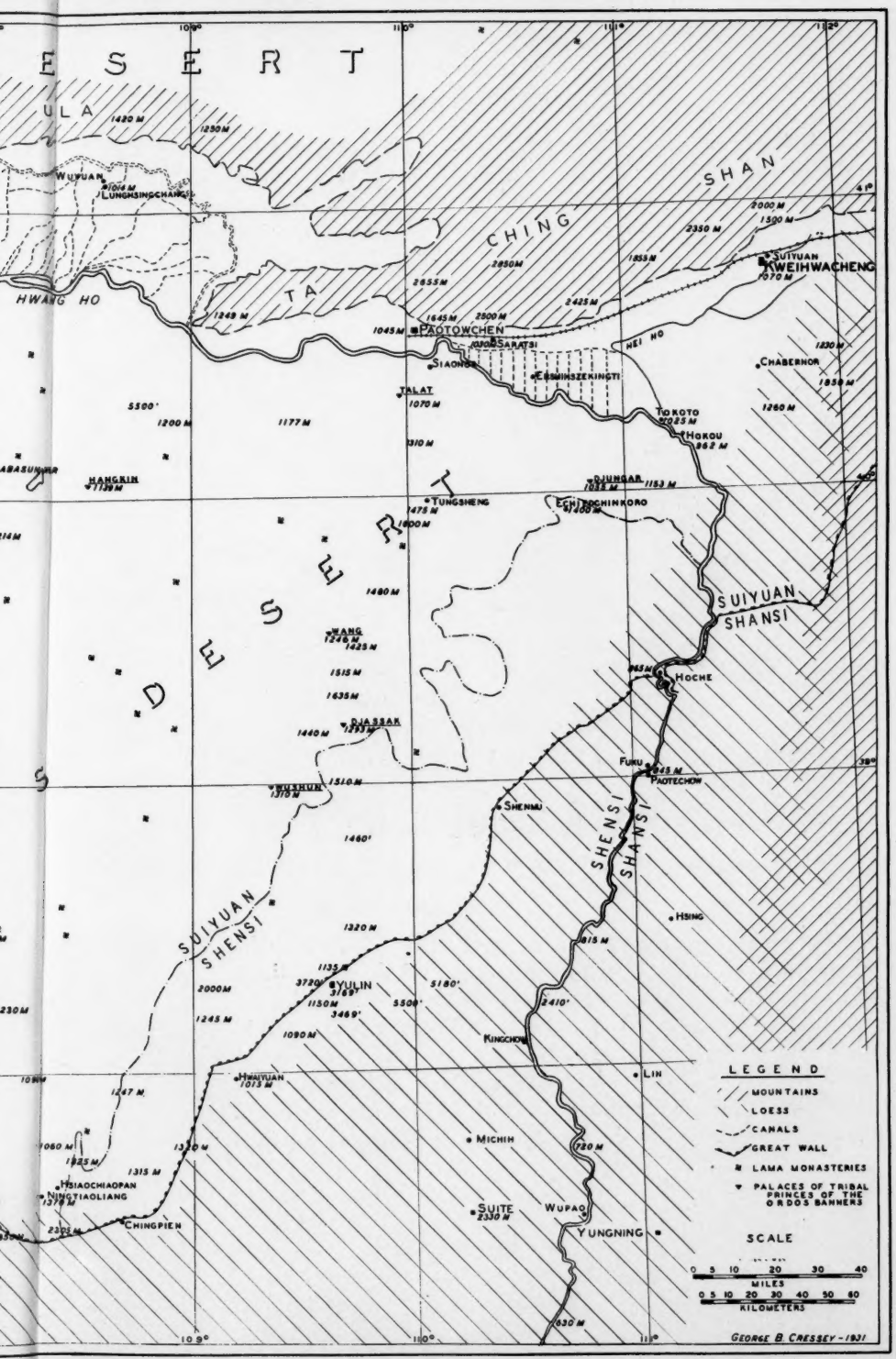

The Ordos is the land of Genghiz Khan. This was one of his first regions of conquest, and the Mongols still relate many legends of his exploits here. During his rule, a tribe of Mongols was moved into this area from the north, from whose name comes our word Tartar. This tribe was charged with the particular duty of guarding the camp or *ordu* of Genghiz. From this responsibility they were called the Ordos Mongols, and the area itself has come

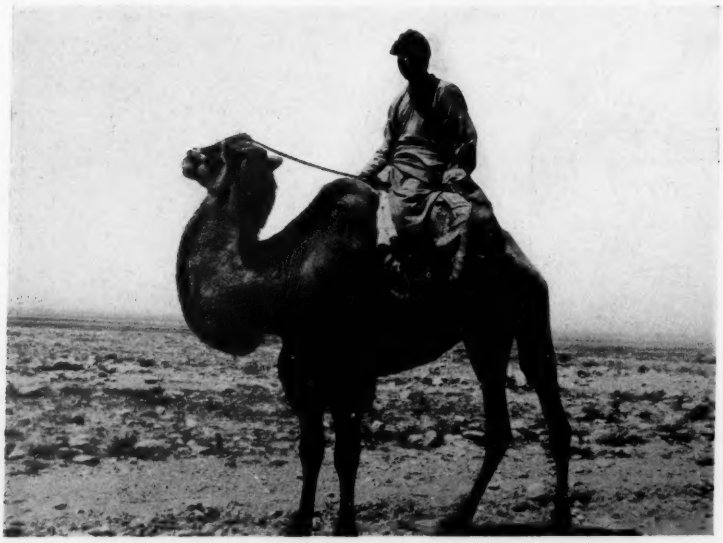

FIG. 2. THE CAMEL IS STILL AN IMPORTANT FACTOR IN TRANSPORTATION OVER ASIATIC DESERTS

to be known by the same name, sometimes written Ordous. The Chinese have no proper name for the area, but they sometimes locally refer to it as Honan, or south of the river. The Ordos lies largely in the new province of Suiyuan, with parts of the area in Shensi and the new province of Ningsia.

The Ordos is no longer occupied by the Mongol nomads alone, for Chinese farmers have pressed in from the east and south and now cultivate the best of the grasslands. The Mongols are thus

restricted to the more barren areas within the enclosure of the Hwang Ho, into the eastern parts of which the agriculturalist is gradually encroaching. In the central portions of the desert none but the nomadic Mongol and his flocks can obtain a living, for this region is destitute of water and timber, and scorched by a tropical sun in summer and swept by icy blasts in winter.

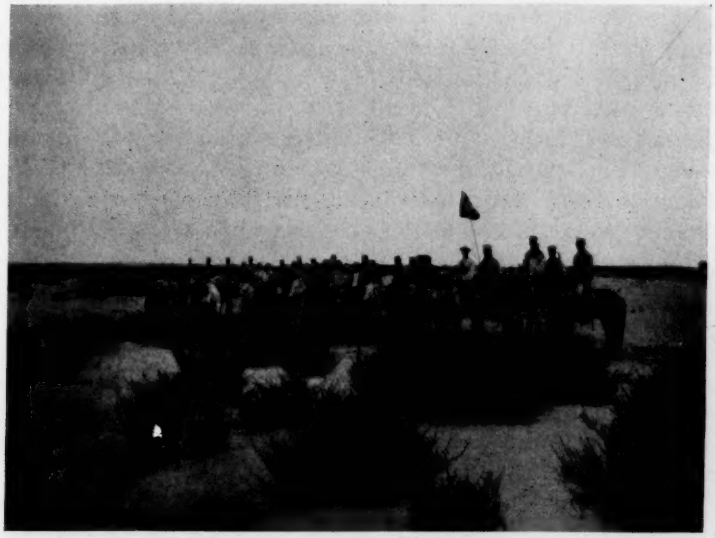

FIG. 3. MILITARY ESCORT PROVIDED FOR PROTECTION AGAINST BRIGANDS INFESTING DESERT BORDERLANDS
The vegetation shown is typical of sand dune areas

The barrenness and monotone of the desert plains produce on some travellers a sense of weariness and depression, while for others the boundless vistas and adventuresome life constitute a challenge which lures them ever onward. Certainly monotonous uniformity is a striking characteristic. Day after day the featureless landscape and unvarying pattern of life press on one with inescapable relentlessness. "Tens, hundreds of miles are passed, but the changeless desert remains sombre and unattrac-

tive as ever. The sun sets, the dark canopy of night descends, the cloudless sky glitters with myriads of stars, and the caravan after proceeding a little further, halts for the night" (*2*).

Not all the Ordos is similarly uninviting. Irrigation from the Hwang Ho or from the encircling mountains has transformed many areas into settled oases. Elsewhere there are steppe lands where large herds of sheep and cattle still graze on rich pastures. Despite these exceptions, the Ordos is not a land for comfortable living. Centuries of hardship and privation have weeded out the unfit, so that the nomads of the Ordos possess a hardy physique and a resourceful ability to adjust themselves to the changing exactions of their environment. Man's achievements in the midst of such meagre resources represent no less an accomplishment than the developments of more "civilized" peoples who have had the best of nature at their command.

3. THE MORPHOLOGY OF THE PHYSICAL LANDSCAPE

Basic Structure

The Ordos is a vast rolling plain. Rugged mountains or dissected hills bound its far horizons. They separate it alike from the plateau of Mongolia on the north and west, and the Loess Highlands of China on the south and east. The average elevation of the Ordos is less than 4000 feet, which makes it an intermediate step from the Gobi, a thousand or more feet higher, to the lower lands of China (*3*).

In his great work "The Face of the Earth," Suess (*4*) devotes considerable attention to the Ordos and its relation to the structure of Asia. Suess considers that the Ordos is a sunken platform or foreland, an *avant pays* of ancient rocks covered with undisturbed Carboniferous and associated strata and veneered with desert sands and recent deposits. Against this shield have been thrust, from north central Asia, the mountains which encircle the desert on the west, northwest, and north. These ranges, which are partially arcuate or *en echelon* are all overturned or thrust faulted toward the Ordos, to which they descend in precipitous slopes. Suess believes that "the whole of the central Gobi, to-

gether with the desert of Alashan, may be regarded as the site of a system of folds, dammed to the east against the foreland of the Ordos."

Suess summarized this masterful theory thirty years ago, before detailed structural studies were available, and based it largely upon reported topographic relationships. The picture of the Ordos just presented is but a part of Suess's larger conception, whereby the structure of Asia has been determined by the southward advance of a nuclear mass, or at least by outward radial movements, from the general vicinity of Irkutsk.

In contrast to this outward directed thrust as conceived by Suess, Willis (*5*) and Hobbs have contended that the actual direction of movement was inward from the Pacific and Indian Oceans. Thus the ancient and crumpled metamorphic rocks of the Gobi would be the buttress against which the force was exerted.

Still another organization of Asiatic structure has been proposed by Argand (*6*) who argues that the mountains of central Asia are due to the union and distortion of various original elements as the whole continental mass drifted southwards. Argand believes that these original masses, of which the Ordos would be one, were the active agents by whose movements the intermediate areas were crumpled into mountain chains. He thus disagrees with Suess who pictured the ancient masses as passive resistant blocks against and around which the mountains were deformed.

The most recent organization of Asiatic structure is presented in a symposium led by Gregory (*7*) who weighs the views of Suess and Argand in the light of present knowledge and concludes that, for central Asia at least, the theories of Suess still hold the field.

Although the Central Asiatic Expeditions of the American Museum of Natural History have not visited the Ordos, the geologists Berkey and Morris (*8*) have given some consideration to the area in defining the boundaries of Mongolia. In their opinion, the character of its topography and physiographic processes, as well as its influence on life, justify the inclusion of the Ordos as a low outlier of the Mongolian plateau. Structurally and petrographically, however, the Ordos gives no evidence of similarity with Mongolia, for the surface is neither a bevelled rock plain nor are the rocks pre-Cambrian metamorphics.

In connection with extensive petroleum investigations for the Standard Oil Company, Fuller and Clapp (*9*) have studied the areas in Kansu, Shensi and Shansi which border the Ordos. They have mapped a large area of Jurassic sediments with a north and south strike which are believed to continue beneath the sands of the Ordos. Similar or related Mesozoic and late Paleozoic formations are known to outcrop near Ningsia, Paotowchen, and Yulin. Fuller and Clapp have therefore named the area between the Taching Shan on the north and the Tsingling Shan on the south, and from the Alashan and Liupan Shan on the west to the ranges of eastern Shansi, the North Shensi Basin. Almost no observations of bed rock geology are available from the interior or the

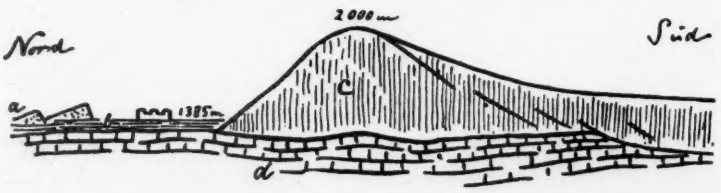

FIG. 4. PROFILE NEAR ANPIEN SHOWING THE RELATION OF THE LOESS PLATEAU TO THE DESERT

(a) Sand dunes; (b) redeposited loess; (c) aeolian loess; (d) underlying sandstone. (After Tafel.)

Ordos, so that its inclusion in this structural unit rests partially upon theoretical grounds. While Fuller and Clapp make no reference to the views of Suess or of Berkey and Morris, it is clear that they would separate the Ordos from the rest of Mongolia.

Encircling Mountains

One of the points of confusion with respect to the characteristics of the Ordos has arisen from the supposed presence of mountains along its southern border. This border roughly corresponds with the line of the Great Wall and is marked by great accumulations of loess (Figs. 4 and 5). The abrupt rise of this loess mantle above the southern Ordos to the height of 1000 to 1500 feet led

early map makers to insert the names of two non-existent mountain ranges, the Paiyu Shan and the Lukwa Shan, still shown on most maps. There is no known structural break between the Ordos and northern Shensi. Topographically, however, there is a marked transition from the bare or sand veneered undulating surface of the Ordos to the sharply dissected loess plateau within the Wall. The loess cover extends northeastward past Yulin and Shenmu and limits the desert to the area outside the Great Wall.

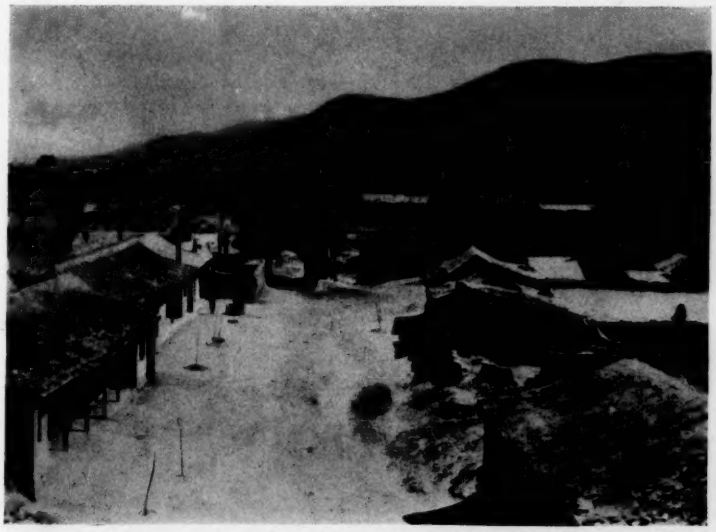

FIG. 5. LOESS PLATEAU RISING ABRUPTLY ABOVE THE DESERT, SOUTH OF CHINGPIEN

Alashan

Of the various ranges which surround the Ordos, the Alashan are the highest and most rugged. (Fig. 6). The word *Alashan* is an inaccurate Chinese transliteration of the Mongol name of the desert to the west which has no reference to the *shan* or mountains. To avoid the confusion which arises from calling both mountains and desert by the same name, Wong Wen-hao

(*10*) of the National Geological Survey of China has proposed that the mountains be known as the Holan Shan, from an old name used in Chinese literature. The range has a length of about 150 miles and an average width of less than one-tenth of that figure. The mountains rise abruptly above the plain on either side, and are especially precipitous on the east where there are sheer cliffs 700 and 800 feet high. The valleys are deep and wild, and the range has an alpine appearance.

FIG. 6. THE ALASHAN MOUNTAINS, WEST OF NINGSIA

There are no isolated peaks, but two higher summit levels rise above the general sky line. These are Bugutui Ula in the north with an elevation of approximately 3600 meters, and Tschun Ula in the south which is about 3500 meters high. The range has no permanent snow fields, although snow may fall in May and June. No trace of Pleistocene glaciation is present. The rainfall is somewhat higher than that of the plain, but the run-off is torrential so that there are few springs or permanent streams. Above 8000 feet are forests of spruce, poplar and willow, with areas of

alpine pasture near the summits. These forests are rapidly being cut, and the timber is used for construction purposes in Ningsia or burned on the spot for charcoal. Deer and mountain goats abound, and wolves, foxes and other animals are reported.

Two passes cross the Alashan to Wangyehfu, variously known as Tingyuanying, Fumafu, Vanvanfu or Alashar. The lower of these lies at 2000 meters and is suitable for cart traffic. During the period of Russian support of General Feng Yu-hsiang in 1926, automobiles carrying munitions regularly travelled from Urga to Wangyehfu and thence across the pass to Ningsia and on to Sianfu (*11*).

The Alashan mountains have been crossed by the writer and are a faulted range thrust to the east on a low angle fault plane which brings Sinian (pre-Cambrian) limestones over crumpled Carboniferous beds. Fault zones are clearly visible, and the structure seems to be that of the Scottish Highlands type with one or more major planes of displacement and several more steeply inclined minor faults. While the strike is typically north and south and the prevailing dips are to the west, numerous exceptions exist. The date of the thrusting appears to be Mesozoic or later.

In the past thousand years, more than twenty destructive earthquakes have been recorded along the foot of the Alashan range between Pinglo and Chungwei. The most diastrous quake was in 1738 when 50,000 people lost their lives.

Arbus Ula

The only mountain area within the Ordos is the Arbus Ula, which lie opposite Shihtsuitzu and on the right bank of the Hwang Ho. These mountains consist of two parts, the Yinze Shan or silver mountains, known to the Mongols as the Kantangar Ula, which lie to the southwest, and the Arbus Ula proper in the northeast. The geology of the area has been studied by the French Fathers Teilhard de Chardin and E. Licent (*12*). Both ranges are simple asymmetrical anticlines, only partially dissected, and the structure is bounded by a thrust fault along the east of

the Arbus Ula. The pressure has clearly come from the west, and the mountains may be regarded as an outlying structure of the Alashan. Another fore-range is found in the small ridge of the Arshan Ula directly south of Houngcheng.

A portion of the crest of the Arbus Ula has escaped erosion and stands out prominently as an isolated flat-topped tableland. Mongolian tradition describes this as the anvil on which Genghiz Khan forged his weapons, so that it is named Orandeshi, the anvil of Genghiz.

Karanarin Ula

Comparatively little is known about the Karanarin Ula, or black pointed mountains, which mark the borders of the Ordos on the northwest. These mountains lie some distance from the present course of the Hwang Ho, and have seldom been visited by travellers. Prejevalsky (*13*) describes the range as follows:

> "From the valley of the river, it presents the appearance of a steep wall, intersected by occasional narrow defiles. Its greatest height is in the middle; but along its whole extent it is wild and barren. Enormous crags of granite, hornblende, gneiss, feldspathic porphry, syenite, feldspar, limestone, and clayey schist furrow the sides of these mountains and crown many of their peaks. . . . . Here and there a shrub of the wild peach or a scanty elm, clings to the mountain side, but otherwise there is very little vegetation of any kind. Nevertheless, animals abound here; numbers of kuku yamens (blue goats, Ovis Burrhel) haunt the rocks, and the argali inhabits the western slopes where the outline of the hill is softer. The peculiarity of this range is the abundance of its springs and watercourses, notwithstanding the entire absence of trees."

The mountainous aspect of the Karanarin Ula is much more pronounced from the side of the Ordos than from the Gobi. Their height is approximately a mile above sea level, which is less than a thousand feet above the level of the Gobi, and twice that amount above the valley of the Hwang Ho. These mountains have a distinct arcuate form, the strike changing from east-west to nearly north 30 degrees east. With diminishing elevations the mountains continue across the Alashan Desert to the west of the Alashan range (*14*).

Taching Shan

The mountains to the north of the Ordos are more complicated in structure than those just described, and have received a variety of names. The term In Shan, or Yin Shan, is used in Chinese historical writings and by many early travellers to designate all of the various ranges. The name most commonly used today is Taching Shan which applies to the mountains parallel to the northern course of the Hwang Ho from beyond Paotowchen to east of Kweihwacheng. The westernmost extension of this range is sometimes named the Muni Ula, or Wula Shan, while another chain lying to the north of the Muni Ula is known as the Scheiten Ula. West of the Schweiten Ula lie the Lang Shan. Where the In Shan face the Ordos, they have precipitous slopes similar to those of the Alashan and Karanarin Ula, with an abrupt transition to the plain (*15*).

An interesting Mongol tradition concerning the origin of the Muni Ula runs as follows. At one time, a Kutukhtu or saint lived in Peking who was so wicked that he was finally imprisoned by the Emperor. Indignant at this treatment, the saint caused an enormous bird to appear in order that it might pick up the capital and overturn it. The Emperor in his fright then released the Kutukhtu who ordered the bird to stop. The bird had already lifted one corner of the city, so that to this day, Peking lies on a gentle slope. The saint then left Peking in order to return to his home in Tibet. Upon reaching the Hwang Ho somewhere in the neighborhood of the Ordos, he found that the Chinese ferryman would not carry him and his horse across the river. This rebuke rekindled his wrath and he rode to northern Mongolia where he selected a large chain of the Altai Mountains and fastened it to his stirrups. He then dragged it south to the Hwang Ho, intending to throw it into the river and so flood the country. The great Buddha himself now appeared in person and compelled the saint to leave the mountains on the bank of the river where they remain to this day as the Muni Ula. The Kutukhtu then threw his belt across the river as a bridge, and crossing on it, he continued to Tibet.

This tradition suggests that the Mongolians may have had some faint conception of mountain origin, for Suess and others have considered that the various ranges of the Taching Shan have been thrust southwards from Outer Mongolia. In the vicinity of Paotowchen and farther west, the rocks dip to the north. The surface of the mountains in many places has a gentle north slope and an abrupt southern face. This is particularly noticeable in the case of the Muni Ula as seen from the west. The interpretation of the Taching Shan is complicated by the presence of a number of faults. In some cases, the fault planes are steeply inclined and may represent either normal displacements or thrust faults which outcrop with high angles.

The most detailed survey of the range is that of C. C. Wang of the Chinese Geological Survey (*16*). The mountains consist of Wutai (Proterozoic) gneiss and schist, and of Carboniferous to Jurassic sandstones and shales with coal beds. From evidence in Shansi, the deformation is thought to be mid-Cretaceous. A number of sharp anticlines and synclines are present, all with an east-west trend. Some of these folds are slightly asymmetrical with the axial plane dipping toward the south. There are numerous faults which Wang considers to be high angle overthrusts from the south. These thrusts increase in importance and regularity from the southern border of the mountains northward. Wang states that "all these observations tend to confirm the northward direction of the thrusting force."

The Scheiten Ula, Lang Shan, and Taching Shan have also been studied by Teilhard de Chardin and Licent, who diagram structures produced by pressures from the north. Wang reconsiders their work, as well as unpublished studies of Wang Wen-hao, and holds that the pressures are all from the south. The entire Taching Shan is throught to be separated from the Kweihwacheng plain by a great normal fault of recent date, which is held to account for the precipitous face of the range. This recent faulting has also produced a rejuvenation of the earlier mature topography (Fig. 7).

Coal is mined south of Chungwei, north of Ningsia, east of Paotowchen, and in the eastern Ordos. In each case native methods

are employed and the coal is used only locally. The only geological survey of the coal beds is that of Wang for the Taching Shan. The seams here are both Permo-Carboniferous and Lower Jurassic, and in the seven fields the reserves amount to 32,000,000 tons of anthracite and 165,000,000 tons of bituminous. The production in the Taching Shan amounts to 23,000 tons annually, the price at the pit averaging Mex. $2.80 per ton. Since transporta-

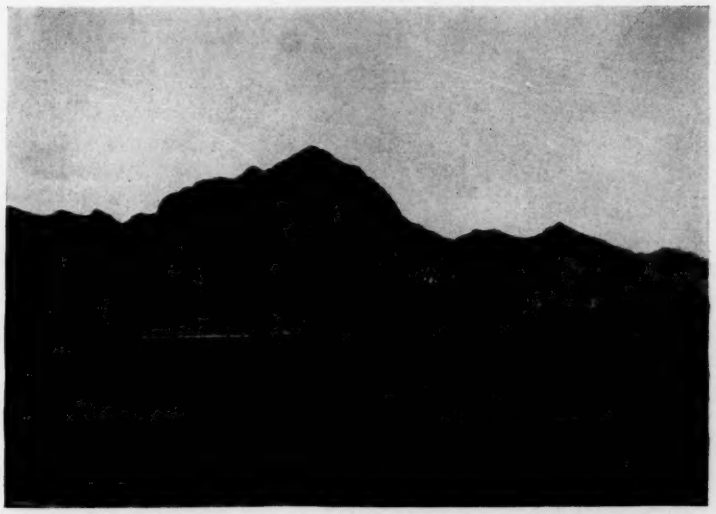

FIG. 7. THE TACHING SHAN RISING ABRUPTLY ABOVE THE CULTIVATED ALLUVIAL SLOPES ALONG THE PEIPING SUIYUAN RAILWAY, NEAR SARATSI

tion is by means of pack animals or carts, the cost increases rapidly at a distance. At Paotowchen, 20 miles from the nearest mine, the price is Mex. $10.00.

Within these encircling mountains lies the undulating plain of the Ordos. The elevations recorded by various travellers are all based upon aneroid readings and do not entirely agree. The elevation of the Hwang Ho decreases from 1215 meters at Chungwei to 960 meters at Hokou. In general the height of the plain in the north and south, and in much of the west, is from 1050 to 1200 meters, rising to 1500 meters in the east.

Hwang Ho

The Hwang Ho is a composite river (*17*). Its course from Tibet to the sea includes at least seven diverse sections, some of them youthful canyons, others broad valleys. Kohler (*18*) has described the various sections and has traced the evolution of the river. The Tibetan portion may once have emptied into the Yangtze, while the section west of Lanchow probably at one time continued eastward by way of the Tao Ho and the Wei Ho.

During Tertiary times, west China and the borders of Tibet were subjected to severe and repeated faulting, so that drainage courses were disturbed and numerous basins were formed in which fresh water lakes developed. One such basin was in the vicinity of Lanchow and was due, probably, to thrust faulting in the Liupan Shan which lies at right angles to the Wei Ho. The water in this lake gradually rose until it spilled over the lowest gap in the rim to the north. The present youthful gorge between Lanchow and Chungwei is supposed to have resulted from vigorous cutting by this new river.

Upon reaching the Ordos, the new Hwang Ho found itself in another enclosed basin, and another lake developed. This lake probably flooded much of the Ordos, except perhaps the higher central and eastern areas, and may have spread into the Alashan Desert as well. Little evidence is available as to this vast lake, comparable in size to the glacial lakes of North America. Lacustrine sediments composed of fine gray silt, poorly consolidated and indistinctly stratified have been found by the writer 25 miles north of Chingpien, 15 miles west of Chungwei, 5 miles east of Santaoho, and 10 miles southwest of Paotowchen.

Prior to the development of Lake Ordos, as the body of water may be termed, a mature river flowed south along the Shansi-Shensi border (*19*). Another river may have had its valley at the foot of the Taching Shan, extending eastward past Kweihwacheng to join the Sankan Ho or the Youngting Ho which unite and flow to Tientsin. The upper portions of this second stream appear to have been cut off by block faulting in the region north of Tatung, but the date of the beheading is not known. Possibly Lake Ordos for a time emptied eastward through such an outlet, or

from the first period of filling it may have overflowed to the south. It is possible that successive faulting may have given rise to several lake episodes, and that tilting of the entire Ordos may have been a factor.

The distance from the point west of Chungwei where the Hwang Ho emerges from its rocky bed through the spurs of the Nan Shan to Hokou where it again enters a youthful gorge is 550 miles as measured along the line of the river, or perhaps 650 miles if all the windings could be counted. In this passage through the Ordos the Hwang Ho everywhere flows on a sandy bed except for a short distance near the Niutou Shan and at Shihtsuitze where the Alashan and the Arbus Ula nearly join. From Chungwei to Hokou the river falls about 835 feet, or 15 inches per mile. This gradient is relatively steep for a large mature river and makes the water turbulent with eddies and small whirls which keep the silt in suspension. The only rapids are associated with constrictions of the channel which are usually due to sand bars.

In the fall of 1924 the writer floated down the river from Ningsia to Paotowchen, a distance of about 425 miles, in 136 hours. During a part of the time the boat was delayed by groundings in shallow water and at other times was helped along by the wind, but the average speed was over three miles per hour, and in places double that figure. The average for this part of the Hwang Ho appears to be roughly three times the normal velocity and gradient of the Mississippi River in the vicinity of St. Louis.

The width of the river varies and the channel occasionally divides into two or more branches. South of Paotowchen the writer measured a width of 275 yards in one place and estimated the distance at 150 yards in another. At Hokou Rockhill reported the width during the winter as 400 yards, and Potanin estimated the normal distance at one-half verst or about 500 yards and the width during floods at 20 li or 12,000 yards. West of Paotowchen Rockhill estimated that the river was about a third of a mile broad, and south of Santaoho he reports widths of 400 to 800 yards. Pereira crossed the river west of Paotowchen and at Shihtsuitze, and reports the width as 400 to 500 yards in each

place. Opposite Ningsia Teichman gives the breadth as three-fourths of a mile, which compares with about a mile as measured from Tafel's maps (*20*), which show a maximum width, including sand bars, of two miles south of Kwanwu. The depth of the main channel is almost everywhere over five feet, and commonly several times that figure. Owing to the shifting sand bars and the swiftness of the current, which makes it difficult to keep in the main channel, navigation is difficult. Although the flatbottomed boats draw no more than three and a half feet of water, they are frequently grounded.

Despite the considerable gradient, numerous meander curves have been developed especially to the west of Paotowchen. In one instance the river flows in an ox bow 10 miles in length while the neck of land separating the river is but two thirds of a mile across.

The only detailed study of the flow and silt content of this part of the Hwang Ho is that made by the China International Famine Relief Commission in connection with its irrigation project south of Saratsi. Todd (*21*) states:

> "The results of these studies show that probably the extreme low water flow at this point is close to 4000 second-feet, and the maximum flood flow is around 150,000 second-feet, or a third of that to be expected in eastern Honan. Also the silt content is remarkably small compared with that in western Shantung where floods give muddiness up to 10 per cent by volume against little over 1 per cent at Tengkow (the intake). In medium to low water this percentage drops to a tenth of 1 per cent. . . . . The fluctuation from extreme low to extreme high water at Intake is a little under ten feet. Flood flows coming from the steeper regions of Kansu have ample time to be "ironed out" as they pass through comparatively flat country for 400 miles before reaching our intake near Tengkow."

Although the silt content of the Hwang Ho is surprisingly low, the river is so turbulent that the water appears very muddy.

In much of its course through the Ordos, the Hwang Ho does not have a distinct valley but rather flows in a channel which is but five to ten feet below the general level of the surrounding plain. Several changes have taken place in the course of the river, particularly in the northwest. At the foot of the Karanarin Ula lies a former channel, still visible and in places filled with water from the canals which irrigate the area about Wuyuan. The time at which the river changed its course here is not known, but

may be approximately inferred from the Jesuit maps of China published with Du Halde's "Description de l'Empire de la Chinoise et de la Tartarie Chinoise." In a general map of China dated 1784 the present channel is indicated somewhat more prominently than those to the north. In another map of western Tartary dated 1711 the present channel is quite subordinate and the river is chiefly divided between three other courses to the north.

No tributary of importance enters the Hwang Ho in its passage through the Ordos except the Hei Ho, which drains the northern portion of the Kweihwacheng plain and enters the Hwang Ho just below Hokou. A few intermittent streams issue from the various mountains, but commonly sink into the sands or are diverted for irrigation before reaching the river. The minor streams shown on most maps are scarcely worthy of mention. The bulk of the Ordos is entirely without permanent streams, and much of the occasional run-off finds its way into enclosed basins. In the steppe lands to the east where the rainfall is somewhat higher there are a few small streams which flow eastward to the Hwang Ho.

Salt Lakes

Numerous salt lakes or pans occupy depressions in the Ordos. The somewhat inaccurate maps of the German General Staff show about a score, the largest of which is Dabasun Nor, sometimes called Karamanni Nor, in the northwest, with a length of 8 miles and a width of one and one-half to two miles. According to Pereira (*22*) the eastern part of the lake is a morass covered with salt crystals like thin ice. Both here and in the southwest near Hwamachih there is an important production of salt, and the same is true in the Alashan Desert west of Tengkow. So little is known of the detailed drainage within the Ordos that the extent of these salt deposits cannot be predicted. Many of the dry stream courses show incrustations of salt.

Recent Sediments

The surface of the Ordos is almost everywhere composed of shifting sands, fluviatile sediments, playa deposits, or lake beds.

Pre-Pliocene consolidated sediments are exposed only in the higher areas or in youthful valleys to the east, and are generally so veneered with drift sands that they have not been described by travellers. Vague references suggest that there may be dissected areas of Cenozoic strata somewhat similar to those studied in the Gobi by the Central Asiatic Expeditions. Since the surface is largely free from vegetation, it is freely exposed to the attack of water and mud. Torrential rains occasionally give rise to floods which either sweep down the dry watercourses or spread out in sheets over the more gentle slopes.

Around the mountains are broad aprons of alluvium, made up of the wash from the numerous ravines. These fans have undergone a complex physiographic history, embracing at least three epochs. The major period of fan accumulation is thought to correspond with the Ma Lan Stage of the Late Pleistocene (*23*), as defined in eastern China, which was a time of aridity. Following the Ma Lan came the Pan Chiao Stage of the Upper Pleistocene when more humid conditions prevailed and erosion was more important than deposition. Still more recently, and corresponding to Recent time, aridity has been increasing and deposition is once more predominant. Thus today one may find small fans being built in valleys cut into former fans. The situation is well shown on both the eastern and western sides of the Alashan. It is not well developed along the southern face of the Taching Shan, either due to recent faulting or to erosion by the Hwang Ho as it may have swung against the mountains.

Sand Dunes

The Ordos is conspicuously a region of aeolian activity. At all seasons the wind blows with velocities sufficient for sand movement. From the mulling over of the shifting sands, quantities of finer particles are lifted into the air. The air is thus characteristically filled with a yellow haze. Loose sands cover a large part of the area, either in the form of bare dunes or in small hillocks gathered about tufts of grass or low brush. The extensive deposits of lake and river alluvium provide an abundant source of supply for both sand and dust.

Several extensive areas of dune accumulation are found in the Ordos. One of these is near the Great Wall between Ningtiaoliang and Yulin, and north. In this region the dunes cover at least a thousand square miles and are advancing to the southeast and piling up against the Great Wall. The writer has travelled across these shifting sands where for hours scarcely a blade of grass is to be seen and where there are no landmarks to guide one. The dunes (Fig. 8) are seldom over 50 feet high, and the material

FIG. 8. SAND DUNES NEAR YULIN
(Photograph by E. L. Estabrook; courtesy of Myron Fuller)

seems to be largely derived from the underlying formations. The sands are brownish ochre in color (National Research Council's color chart after Ridgeway, 17½h), and have a considerable amount of fine silt. This dust is easily lifted by the wind so that dust storms are frequent.

Another area of extensive dune accumulation lies in the northwest, both within the elbow of the Hwang Ho where the dunes are called the Kuzupchi Sands, and on the left bank of the river between the Holan Shan and the Karanarin Ula. Only the borders of these dune areas have been seen by the writer, but they

do not appear to be as extensive as those in the southeast. Prejevalsky (*24*) thus describes the aspect of the Kuzupchi sands.

"The effect of these bare yellow hillocks is most dreary and depressing when you are among them, and can see nothing but the sky and the sand; not a plant, not an animal, is visible, with the single exception of the yellowish gray lizards (phrynocephalus sp) which trail their bodies over the loose soil and mark it with the patterns of their tracks. A dull heaviness oppresses the sense in this inanimate sea of sand. No sounds are heard, not even the chirping of the grasshopper, the silence of the tomb surrounds you. No wonder that the Mongols relate some marvellous stories about these frightful deserts."

FIG. 9. DUNES OF BROWNISH SAND, NEAR NINGTIAOLIANG

The highest dune area in this region lies just to the west of Chungwei where a great river of sand is advancing to the banks of the Hwang Ho. These dunes originate in the southern Alashan, near the area where lake sediments have been noted by the writer, and fill a broad valley between the Holan Shan and the spurs of the Nan Shan, here known as the Datsopei Shan. The dunes rise to a measured height of 500 feet above the river, and are among the highest in the world (Fig. 9). The immense

quantities of sand which they contribute to the Hwang Ho are partially responsible for the many sand bars and islands in the vicinity of Chungwei.

In all parts of the Ordos, including the more moist eastern sections, small dunes from 6 to 15 feet high are scattered here and there. In some cases these have the true crescentic or barchon shape, but more commonly they have no definite form. In all but the larger dune area small tracts here and there are free from sand. Where water is available these form oases for grazing or agriculture. If grass is present, such depressions are termed tsaidams.

Loess

The finer portions of the wind blown material are sooner or later lifted from the surface and carried out of the Ordos to the areas within the Great Wall where they are spread over the surface of hill and valley alike as though dropped from a giant flour sifter. The material now slowly accumulating is identical in composition and origin with the loess. It seems probable that the major part of the loess of Kansu, Shensi, and Shansi has been derived in like manner from the working over of the surface materials of the Ordos. Here in the desert abundant supplies have been made available through the distinctive lacustrine and fluviatile history of the area. The regions to the south of the Ordos and to the east of Lanchow are the loess land par excellance of the world. No similar accumulations are present in northern Shansi or Chihli where the Gobi abuts on the Great Wall, and in view of the very different physiographic history of the Gobi, it does not seem likely that central Mongolia could have supplied the bulk of the loess of China. For centuries upon centuries the Ordos has been receiving the sediments of the upper Hwang Ho, and these comminuted materials have formed an easy prey to the attack of the wind. The coarser units of these river-contributed sediments are now represented in the sand dunes which girdle the southeastern Ordos, while the finer particles have been transported extraterritorially to build up the loess. Scattered deposits of loess are found here and there within the Ordos, but they are neither common nor well developed.

Soils

No studies have been made of the soils of the Ordos, but they presumably belong to the Grayerths of the Pedocal group. For the most part the soils are immature, and the alluvium represents soil material, generally with poorly marked profiles. It is characteristic of such arid regions that the soils contain a high percentage of soluble substances such as lime and nitrogenous materials which are not washed out by rainfall as in more humid regions. Where water is available, these desert soils are valuable for agriculture.

Where ground water stands near the surface, as in depressions, or where the surface layers are moistened by irrigation, capillary attraction brings water to the surface where it is evaporated, leaving its chemical load behind. If not washed out, these salts accumulate and develop a degree of alkalinity sufficiently high to prevent the growth of most plants. In many places the ground is whitened with their efflorescence. These salts are commonly the sulphates, chlorides, and carbonates of sodium, and calcium and magnesium sulphates. Where such materials accumulate in sufficient quantities to form crusts on the surface, they are known as caliche. Considerable tracts of land near the Hwang Ho, particularly in the areas at present or previously irrigated, are now unfit for agriculture because of their alkalinity. Such land may be reclaimed either by subdrainage and flushing out the soluble chemicals, or by growing certain tolerant plants which take up the alkalis into their structure so that the plants may then be cut and burned.

4. CLIMATE, THE KEY TO LANDSCAPE AND LIFE

Aridity

The greater part of the Ordos is an arid desolate plain, parched by a blazing sun in summer and swept by icy blasts in winter. Shifting sands held here and there by low scrub or wiry grass make the region an inhospitable waste where nature offers but little to man, and yields that little grudgingly. Only where canals from the encircling Hwang Ho or transient streams from the

marginal mountains supply water for irrigation is there a certainty of agricultural prosperity. Elsewhere this is the land of the nomad, particularly in the east where the increased rainfall converts the true desert to the steppe. The few available climatic data are given in table 1.

During the summer months, the sun shining down from a cloudless sky heats the sand to extraordinary temperatures. Chernos (*25*) reports a temperature of the sand in the western Ordos near the Arbus Ula on May 26, 1908 of 64°C. or 147°F. This heating of the surface warms the air and produces strong convectional currents. The humidity is commonly low, but where the air contains sufficient moisture, these upward currents may give rise to cumulus clouds which gradually increase in size and number during the morning until by noon they sometimes cover the sky. Occasionally these clouds develop thunder heads and produce sharp local showers. Even when rain may be seen to fall from these clouds, the air may be so thirsty the rain evaporates before reaching the ground.

The nights are invariably clear, and the stars glisten with a brilliance which they seldom have in more humid lands at lower altitudes.

Temperature

Summer temperatures regularly rise to 38°C. (100°F.) and drop to −35°C. (−30°F.) during the long winter. On the eighth of July, 1928, the writer observed a temperature at Paotowchen of 39°C. (102°F.) with an overcast sky, while for the winter of 1929–30 at Saratsi, 30 miles to the east, Todd (*26*) reports temperatures of −40°F. (−40°C.). The Hwang Ho is frozen from the end of November until March, and the ice is usually three feet thick. Since the winter days are bright and sunny and a snow cover is unusual, noonday temperatures in the sun and away from a wind not infrequently rise above freezing. Such is the regular condition for the central Asiatic winter.

Continuous records of temperature are available only for the mission station of Ershihszekingti near Saratsi for 1910–16, and for November, December and January, 1908–9 at Yulin, Yenan

TABLE 1

Climatic data

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER	YEAR
Ershihszekingti													
Latitude 40° 36′. Longitude 110° 30′. Catholic Mission Station													
Located near the northeastern bend of the Hwang Ho southeast of Saratsi													
Elevation 1025 meters													
Data from: Gherzi, "La Pluie en Chine," vol. I, p. 110													
Gauthier, "La Temperature en Chine"													
Kohler, "Der Hwang Ho"													
Temperature (°C., 1910–16, partially incomplete):													
Extreme maximum	3.0	10.0	17.0	27.0	34.4	37.0	37.0	34.4	30.0	25.0	15.0	1.0	
Average	−15.1	−9.3	0.0	8.1	15.8	20.4	22.7	20.9	14.3	6.7	−4.3	−15.2	5.36
Extreme minimum	−35.0	−32.0	−19.0	−10.0	−1.0	2.0	8.0	4.0	0.0	−7.0	−26.0	−35.0	
Rainfall (1917–25):													
Days of rain	0.5	0.5	0.8	1.3	3.4	5.1	8.7	7.7	4.0	1.4	0.6	0.3	34.3
Millimeters	0.3	3.8	3.4	5.2	14.1	61.1	101.9	78.0	47.3	14.9	1.8	3.2	335.0
Dust storms (1920–24):													
Number	2	2	5	4	5	2	1	0	1	1	2	1	26
Kweihwacheng													
Latitude 40° 48′N. Longitude 111° 38′E.													
Located near the northeastern bend of the Hwang Ho near the Taching Shan													
Data from Gherzi, "La Pluie en Chine"													
Rainfall (1920–25):													
Days of rain	0.4	1.7	1.3	1.2	4.2	4.8	6.6	8.8	4.2	2.2	1.0	0.4	36.8
Millimeters	0.4	4.5	3.5	7.0	23.3	59.0	75.9	121.0	63.5	20.7	3.8	2.1	384.7

Chabernor

Latitude 40° 31′N. Longitude 111° 42′E. Catholic Mission Station
Located near the northeastern bend of the Hwang Ho, south of Kweihwachang
Data from Gherzi, "La Pluie en Chine"

Rainfall (1920–24):													
Days of rain	3.5	4.2	4.0	5.0	9.0	10.4	12.8	12.6	9.4	4.4	1.2	2.5	79
Millimeters	4.3	3.8	3.2	8.5	21.5	70.0	84.0	71.9	46.4	18.9	6.4	1.1	340

Saratsi

Located near the northeastern bend of the Hwang Ho on the Paotowchen-Kweihwacheng plain
Elevation 1025 meters
Data from Todd, "Getting Yellow River Water on the Saratsi Plain"

Rainfall (1929–30):													
Millimeters	—	13	—	—	44	23	*103.3 †59.7	102.6 13.2	12.4 59.2	2	—	19.1	

Santaoho

Latitude 40° 15′N. Longitude 106° 42′E. Catholic Mission Station
Located near the Hwang Ho in its northeastern bend, on broad plain
Elevation 1050 meters
Data from: Gherzi, "La Pluie en Chine"
Kohler, "Der Hwang Ho"

Rainfall (1920–25):													
Days of rain	0.8	1.0	1.7	1.6	3.0	3.2	6.8	7.2	3.8	0.8	1.4	1.2	32.5
Dust storms (1920–24):													
Number	7	3	7	5	5	2	1	1	2	3	7	6	49

* 1929.
† 1930.

and vicinity, outside the southeastern corner of the Ordos and 200 miles south of Ershihszekingti. The record for Ershihszekingti shows average temperatures as follows: May, 15.8°C., June, 20.4°C., July, 22.7°C., August, 20.9°C., and September, 14.3°C., in contrast to winter averages of November, −4.3°C., December, −15.2°C., January, −15.1°C., February, −9.3°C., and March, 0°C. Spring and fall have but little entity in themselves, and are merely brief transition periods. The records for Yulin and Yenan (*27*) are slightly incomplete and are not given in terms of averages, but if these are computed from the available data, the figures are November, 36.1°F. (1.8°C.), December, 25.9°F. (−2.7°C.), January, 21.4°F. (−4.7°C.). Even colder winter conditions than those recorded at Ershihszekingti probably occur in the central and northwestern areas away from the protection of the mountains which partially screen the northern valley of the Hwang Ho from the cold winds of Outer Mongolia. Obruchev (*28*) reported temperatures of −30°C. in the southern Ordos in January, and Hedin (*29*) recorded −30°C. and −33°C. in the heart of the Ordos on February 2nd and 3rd, 1897.

Wind

The winds of the Ordos are strong, due in part to marked temperature and barometric contrasts, and also to the absence of obstructions. There is, however, no regular wind system as is found in the monsoon lands near the margins of Asia. There is a tendency for northwest winds in winter and southeast winds in summer, but this tendency is overcome by occasional cyclonic storms from interior Asia and by local storms arising from convectional circulation. These periods of high velocities are interspersed with times of calm or light airs.

According to Tafel (*30*), who has crossed the Ordos and travelled extensively in Shensi and Kansu, the effective limit of the southeast monsoon corresponds with the line of the Great Wall, including its northward extension around Ningsia. This extreme penetration of the moisture bearing winds from the ocean marks the general limit of continuous grass cover and the steppe, and agrees with the northern margin of extensive loess deposits.

Along this transitional zone agriculturalist and nomad meet in contest, the former seeking additional crop land to care for the ever expanding population of settled China, and the latter in quest of better pastures for his never too well fed flocks. With cyclic variations in rainfall, the potential usability of the land has varied, and the human boundary has shifted north or south.

Both in summer and winter the monsoon circulation is feeble, seldom producing strong winds. During their stay at Yulin and Yenan from November through January, 1908–9, Clark and Sowerby reported light variable winds, predominantly from the north and northwest. Only twice were there strong winds, once from the north and once from the northwest. Tafel (*31*) likewise records calms from May to August in the eastern and southern part of the area. The writer, however, experienced two violent sand storms with southerly winds having estimated velocities of 30 to 35 miles per hour in June, 1924, in the southern Ordos. During his travels in the eastern and southern Ordos during August and September, 1884, Potanin (*32*) recorded 56 wind observations, of which 11 each were west and south, 10 northwest, and 9 southwest. Unfortunately, he makes no mention of their intensity. On the whole, the winds during the winter months are considerably stronger than in the summer and are more constant in direction.

The winds at Santaoho (*33*) are predominantly from the west at all seasons. From the beginning of November to the middle of April, there is usually a dust-laden northwest wind, which, however, is confined to the daytime, the nights being clear and calm. During Nove nber and December, half the days are overcast due to the dust. Obruchev in writing of Santaoho in 1893 speaks of the west winds which blow with great force during the spring and autumn, and also referred to the storms of dust and sand. In December, he records the wind as northwest. Hedin also describes the icy northwest winds of the central Ordos in February. According to the records at Ershihszekingti (*34*), 180 miles to the east, these northwest winds continue to blow during May and June. During the summer, westerly and northeasterly winds predominate at Santaoho, with southeast winds

only exceptionally. Dust storms are to be expected during every month, but are less common from June to September when the ground is more blanketed by vegetation. The yearly average for Santaoho is 49 storms. The more exposed position of Santaoho and its lower rainfall is illustrated by the fact that at Ershihsze-kingti there is an average of only 26 dust storms per year.

FIG. 10. SAND DUNES NEAR YULIN

In this district only the towers of the Great Wall were built of brick; the wall itself was of mud, and has been largely washed or blown away. (Photograph by F. M. Exner.)

The flat bottomed boats which float down the Hwang Ho from Chungwei to Paotowchen are frequently in danger of being blown on to sand bars by the strong winds. During twenty days spent by the writer on the river in August and September 1924, there were two cases of strong winds from the south and two from the northeast.

Perhaps the best record of prevailing wind directions is found in the distribution of sand dunes and in their orientation. The

two principal dune areas are the Kuzupchi Sands in the northwest just within the bend of the river, and the extensive sand area which spreads over a thousand square miles in the southeast near Yulin (Fig. 10). The Kuzupchi Sands are little known, but may have been derived in part from river alluvium under the influence of northwest winds in the area where the river has

FIG. 11. SMALL DUNES FORMED BY VEGETATION CHECKING THE VELOCITY OF THE WIND

changed its course. The dune area lying southwest of Yulin is advancing across the Great Wall, covering the cultivated fields to the east and is threatening to engulf the city itself. There is here clear evidence of eastward movement of the sand and thus of the prevalence of westerly winds stronger than those from other directions.

When Obruchev crossed the western Ordos, he found that all of the dune areas were linear, often alternating with tsaidams, and that the general orientation was from northwest to southeast, or parallel with the wind. Other isolated dune ridges, not asso-

ciated with tsaidams, were found extending northeast and southwest, or at right angles to the wind. The steep lee slopes of individual dunes are invariably on the east or east-southeast, as are the sand accumulations about clumps of vegetation (Fig. 11). This general condition has been confirmed by numerous travellers, including the writer, in different parts of the desert.

Rainfall

The Ordos is a land of limited and uncertain rainfall. Much of the area is a true desert while the rest lies on the fringe of the steppe where there is barely sufficient rain in the good seasons for a precarious agriculture. Over most of the region the annual precipitation probably amounts to no more than 200 millimeters or 8 inches, half of which comes during July and August. Snow falls seldom and soon evaporates. Except for local orographic influences, the rainfall increases from north to south and from west to east.

Records of rainfall are available only for stations located near the mountains in the north where conditions are not representative of the central desert. At Kweihwacheng, Chabernor, and Ershihszekingti, all outside the bend of the Hwang Ho in the northeast, the annual precipitation amounts to 384.7, 340 and 335 millimeters, decreasing from east to west, or an average of 14 inches. The number of rainy days is known for these stations and also for Santaoho in the northwest. With the exception of Chabernor, the frequency of rainfall likewise shows a progressive decrease toward the west, with 36.8, 79, 34.3, and 32.5 days, respectively. These numbers can scarcely be typical of the region as a whole, for in 58 days spent by the writer in the Ordos and vicinity during June, July, August and September in 1924 and 1928, but five days had any rain. Three were sharp showers, once with thunder, lasting not over half an hour; while the other two were steady drizzles which continued for a part of a day.

In the encircling mountains, the rain and snowfall is somewhat greater than on the plain, but even here it is not abundant. The mountain slopes are rocky, devoid of vegetation except near the summits, and lack permanent streams.

Vegetation

In the absence of adequate rainfall records, the relative aridity may be deduced from the character of the natural vegetation and human occupation. Apart from the numerous areas of bare sand, much of the region enclosed within the Hwang Ho and the Great Wall has a sparse growth of drought-resisting plants, with special adaptations for securing water and resisting transpiration. These forms consist of wiry bunch grasses and low shrubs which nowhere provide a continuous cover for the soil, so that a space of a foot or more intervenes between each plant. Trees are almost entirely absent and only in a few especially favored areas, such as low basins or tsaidams and the regions to the east where the rainfall is slightly greater, is the grass adequate for horses or cattle.

Santaoho is an oasis in the midst of the most desolate part of the course of the Hwang Ho. Founded by the Catholic missionaries, it owes its economic life to their support and to irrigation. A few trees grow along the canals, and a precarious cultivation supports the several thousand converts who live a rather miserable existence. Only the most drought resisting forms of plant life can live here without irrigation, and no crops are raised without it. There is scarcely a single habitation or cultivated field for tens of miles in any direction away from the oasis, even along the Hwang Ho. Across the river in low areas near water level are tracts of scrub willow which grows from four to six feet high, interspersed with tall wiry grass.

The oasis around Ningsia at the foot of the Holan Shan could scarcely exist without irrigation. The mountains rise considerably more than a mile above the level of the plain and intercept the last traces of moisture from the southeastern monsoon. Both at Ningsia and Santaoho, and more especially on the right bank of the river, numerous tracts of soil are white with salt or alkali so that nothing grows. Except in the extreme southwest in the vicinity of Ningling, no irrigation has been developed on the right bank of the Hwang Ho anywhere within the Ordos, and the desert with its typical flora comes almost to the water's edge.

Along the southern margin of the Ordos, the true desert boundary extends approximately through Hwamachih and Anpien. To the west of Hwamachih, the desert margin lies considerably south of the Great Wall, while north of Chingpien is an area outside the Wall with good pasture in the tsaidams and considerable agriculture, so that the desert boundary is near Ningtiaoling.

Parts of the eastern Ordos are more of a steppe than a desert, and the natural vegetation is comparatively more luxurious, so that it nearly carpets the ground. Short grasses afford some feed for animals and make the area better for both nomad and farmer. The western limit of this semi-humid area is along a line roughly connecting Paotowchen and Yulin. In travelling between these two cities in 1905, Tafel (*35*) found from two to four farm families every 30 to 40 kilometers. The sparseness suggests the marginal character of this section of the Ordos. Even eastward from the Great Wall to the Hwang Ho, north of Yulin, the land supports only a poor steppe vegetation and the population is scattered.

While the vegetation of the desert is anything but cheerful at most seasons, the brief summer rains bring to life a considerable variety of plants. Most conspicuous are the flowers which carpet the surface over acre after acre. Such forms as yellow hyacinths, purple daisies, yellow and blue bells, and morning glories were found in great profusion in the southern Ordos by the writer in June, 1924.

Animal Life

Amid such a desolate environment, it is but natural that animal life should be limited. Numerous lizards, a few rabbits, pheasants and quail, and small herds of *antilope gutterosa* are the chief forms.

5. FOUR THOUSAND YEARS OF CONTEST

A Contest Zone

The record of the Ordos throws light on the history of China as a whole. Situated in the marginal zone between the desert and the steppe, this land has witnessed a never ceasing contest between the wandering nomad and the settled farmer, sometimes through

warfare and sometimes through more peaceful penetration. Time after time, tribes from the reservoirs of humanity in interior Asia have surged into the border land of the Ordos, either to occupy it for a few centuries or to move on to the richer treasures within the Great Wall to the south and east (*36*).

The Ordos is an old land. Two thousand years or more before recorded history begins in south China, the Ordos and adjoining region was known and settled. Whether or not the Chinese race migrated from somewhere far to the westward or originated within China, much of their development occurred in the highlands and plains of Shensi and Kansu. In the vicinity of Titao, south of Lanchow, Anderson (*37*) found in 1923 numerous skeletons and a rich collection of pottery which carry back the known history of the Chinese several thousand years.

Long before the rise of the Chinese race, eastern Asia was the home of man. Excavations at Chukoutien near Peiping, still in progress, have already yielded several human skulls fully as old as anything known, dating back to the early Pleistocene and ranking with the Java and Piltdown men. Whether or not some still undiscovered region in central Asia may have been the birthplace of mankind, it is clear that man dwelt in north China at as early a period as elsewhere. That the Ordos was inhabited during these early stages of evolution is shown by the discovery of Mousterian artifacts by Teilhard de Chardin and Licent (*38*) in 1923 near Houngcheng along the Great Wall not far from the point where it meets the Hwang Ho opposite Ningsia. Similar material has been discovered in Outer Mongolia where the Third Asiatic Expedition of the American Museum of Natural History (*39*) found traces of Neanderthal culture, as well as of a race of "Dune Dwellers" who lived some 20,000 years ago.

Early Records

The earliest historical reference to the region of the Ordos is at the time of the Hsia Dynasty which is supposed to have ruled China in 2200 B.C. The historian Ssu Ma-chien (*40*) states that the area then formed a portion of the district of Yung Chow, but unfortunately he makes no reference to the character of the region

or to the type of land utilization. Following this time, there are but fragmentary accounts of wars and migrations until the close of the Chou Dynasty, 2000 years later, when the nomadic tribes living in the Ordos and vicinity were the warlike Hsiung Nu who later figured prominently in the history of the northwest.

During the third century before the Christian era, at the period of general disorder known as the Seven Kingdoms, north China was occupied by several petty states; one, known as Ch'in from

FIG. 12. THE GREAT WALL WEST OF ANPIEN
Conforming to common practice in the Ordos, it is built of pounded earth

the name of the ruler, occupied Shensi and Kansu. As was the custom of the period, each of these states built defense walls (Fig. 12), partly for protection against the others, but especially for defense against the nomadic tribes of Mongolia and Manchuria to the north. The wall of Ch'in extended from Titao to Yulin by way of Pingliang. East of the Taching Shan was a series of unrelated walls extending to the Gulf of Liaotung. Apparently there was no wall between Yulin and the Taching Shan. About 200 B.C. the other kingdoms were conquered by

the King of Ch'in who connected the various walls to form a continuous barrier from the edges of Tibet to the sea. The exact position of the Great Wall of that period is uncertain, but for considerable distances it did not coincide with that known today, particularly in the region of the Ordos. Vague references even suggest that a wall extended around the west and north of the Ordos, entirely inclosing the Hwang Ho, and still other walls are mentioned in and north of the Taching Shan, ruins of which are still visible. Since most of these early defense walls were mere ridges of mud, faced in part with sun-dried bricks, little trace remains of them today. The present line of the Great Wall south and east of the Ordos does not date back farther than the Sung and Ming Dynasties, that is about 1000 A.D. (*41*). The shifting positions of these walls give a suggestion of the fluctuating contest between the settled agriculturist and the nomad. Unfortunately, the available data are too inadequate to warrant safe inferences.

Han Dynasty

During the Han Dynasty, some 2000 years ago, several references describe difficulties with the Hsiung Nu who lived outside the wall to the northwest and frequently raided the settled lands of China. Campaigns against them are recorded under the Emperor Wu Ti in 119 B.C. and also in 93 B.C.; in the former campaign his army is reported to have numbered 180,000 horsemen.

The Han Dynasty took a census (*42*) of the northwestern border lands which gives us a valuable picture of their settlement. It records the location, population, and number of hsien or counties by districts, of which there were seven in the general vicinity of the Ordos.

The recorded population of these districts aggregated nearly two million, a very considerable part of whom were living south of the Great Wall. In the absence of accurate boundaries, and with no certainty as to the accuracy of the Han census, it is difficult to make accurate comparisons with the situation today. An examination of the population figures for the various hsien of the

present day, as recorded by the Chinese Post Office in 1926, indicates that the total population today is not over a million and a half, or somewhat less than the figure for 2000 years ago. Then as now, the areas of settlement were concentrated in the valley of the Hwang Ho and in the regions south and east where increased rainfall permits a growth of grass. It appears quite unlikely that what is now the real desert has ever supported a dense population, although a few ruins suggest a somewhat larger number of people at some time in the past than today, due no doubt, to periods of more favorable rainfall. The apparent lack of any increase in population in the area of the Ordos is the more striking when compared with the growth in population of China as a whole. Usher (*43*) states that the recorded population of China in the year 2 A. D. was 59.5 millions, which he increases to 70 millions to allow for omissions. This is to be contrasted with the Post Office estimates for 1926 of 485 millions.

Apparently, the Ordos did not continue to remain a part of China, for 700 years later in the days of the Tang Dynasty, the records reveal that the Turks who then occupied the Ordos, northern Shensi and Kansu were subdued by the Emperor Tai Tsung. Following the defeat of the Turks, the region was occupied successively by Mohammedans and Tufan.

One of the most prominent of the successive states which arose in the northwest was the Kingdom of Hsia, founded by Yuen Hou in 1038 with the capital at Ningsia, then known as Chunghsingfu. Yuen Hou reduced the Hsia language to writing and translated many of the Chinese classics for his tribesmen. His army is said to have numbered 158,000 soldiers. The Hsia Kingdom lasted two stormy centuries, marked by frequent wars with the Sung rulers in China and the Kins in Manchuria. The final collapse was not due to these enemies, however, but came from a new power in the north.

Genghiz Khan

Genghiz Khan, the first of the Mongol leaders who swept down from the Gobi across this area, required four and possibly five campaigns to subdue the Hsia Kingdom. In 1207, the second

year of the Khan's reign, he invaded the area, and in 1209 laid siege to Ningsia. In order to flood the city Genghiz ordered that great dikes be built to divert the irrigation canals which surround the town. The Mongol accounts report that the dikes were accidently broken so that the Mongol camp became flooded, whereupon the army withdrew. The Chinese record, however, describes how the inhabitants of the city themselves cut the dikes and thus compelled the Mongols to lift the siege.

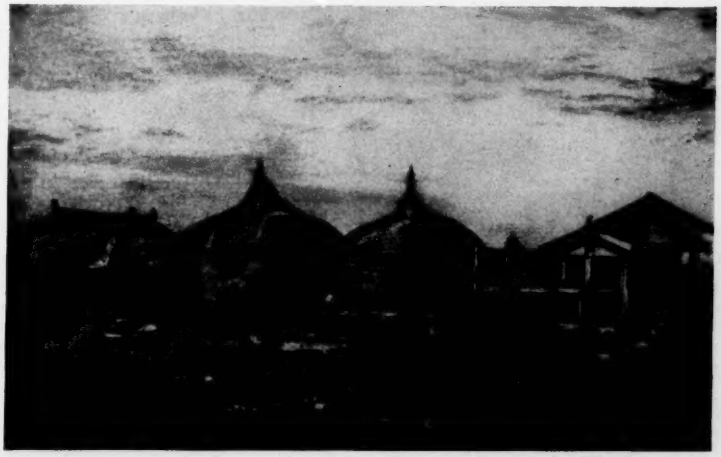

FIG. 13. THE TOMB OF GENGHIZ KHAN AT ECHI EDCHEN KORO
The coffin is in the large yurt at the left. (After an etching by Potanin.)

In the summer of 1227, not having as yet conquered the Kingdom of Hsia, the Khan once more attacked Ningsia which surrendered after a siege of three months. Shortly afterwards, Genghiz died at Chingshui in southeastern Kansu. The location of his tomb has long been in dispute. Some writers have contended that he was buried near the Siberian border in his boyhood home along the Kerulen River, but the evidence is indirect. It now seems probable that the Khan's tomb is in the eastern Ordos at a place known as Echi Edchin Koro (Fig. 13), variously spelled as E-chin-ho-lao or Etjen Koro.

Echi Edchin Koro is merely a Mongol encampment and is located southeast of the recently established village of Tungsheng Hsien and about 180 li northwest of Shenmu. The tomb was visited by Potanin (*44*) in 1884, Bonin (*45*) in 1897, and De Lesdain (*46*) in 1904. The most detailed account is given by Werner (*47*), based upon Chinese and Mongol sources. These writers and various Mongols with whom the author has conversed, agree that this is the real burial place of the great Khan. The locality is guarded by a small tribe of Mongols, known as the Tarhat, set apart for the purpose, and no foreigner has been able to visit the area within recent years.

The tomb consists of two yurts with gilded spires, set on a low terrace, of which one serves as an entrance and ceremonial room for the other. Within the inner yurt, the ashes of Genghiz are preserved in a silver coffin contained in a copper chest. As in all Mongol temples, various flags and the pieces of silk known as *hadas* have been contributed by pilgrims and line the walls. Each spring on the 21st day of the 3rd moon, a special ceremony honors the memory of the Khan.

During the rule of Genghiz, a tribe was transferred from northern Mongolia to the Taching Shan which became known to the Chinese as the *Tata*, from which has come our word Tartar. Following the close of the Yuan or Mongol Dynasty in 1368, the Tartars who continued to occupy the Ordos proved a strong obstacle to the Mings for over a century. Toward the close of the Ming rule, the tribes of the Ordos became partly subject to the court at Peking, but not until the Manchus conquered China in the middle of the sixteenth century did the Ordos form an integral part of the Chinese Empire. Since that time, Chinese agriculturalists have penetrated steadily into the region until they now occupy the valley of the Hwang Ho to the practical exclusion of the nomadic Mongols.

The Mohammedan Rebellion which swept over the northwestern provinces of China from 1861 to 1878, several times brought disorder in the Ordos, particularly to the valley of the Hwang Ho. Around Ningsia, the rural population was decimated and is only now recovering.

The troubled history of this area merely reflects the influence of its transitional location between the deserts of central Asia and the more humid lands of China proper. From the dawn of history, the principal avenues of intercourse between the coastal lowlands and the interior plateaus have passed either through the Ordos itself or along nearby routes to the south or northeast. Repeatedly the hungry wanderers of the desert have swept across the region to seek plunder or more favorable conditions of life in settled China. As often, the persistent Chinese have pushed back the nomads, sometimes by military campaigns but more often by the quiet pressure of slow penetration. Hsiung Nu, Turk, Modammedan, Tufan, Hsia, Tartar and Chinese are but some of the races which have found homes here. It would seem probable that many of these movements are related to changes in climate and thus of vegetation and potential utilization, but adequate data for correlation are not available and the problem is so complicated by the state of government both in this vicinity and elsewhere that no significant conclusions are warranted.

6. EXPLORING THE SECRETS OF THE ORDOS

Marco Polo

Chinese literature contains but few references to the geography of the Ordos, and the exploration and description of the region has been largely undertaken by Europeans. Of the various mediaeval travellers who reached China by way of central Asia, only Marco Polo has given any detailed record of his route. In the exasperatingly fragmentary account of his travels, Marco has written as follows (*48*):

"Starting from Erguiul you ride eastward for eight days, and then come to a province called Egrigaia, containing numerous cities and villages, and belonging to Tangut. The capital city is called Calachan. The people are chiefly idolaters, but there are fine churches belonging to the Nestorian Christians. They are all subjects of the Great Kaan. They make in this city great quantities of camlets of camel's wool, the finest in the world; and some of the camlets that they make are white, for they have white camels, and these are the best of all. Merchants purchase these stuffs here, and carry them over the world for sale.

"We shall now proceed eastward from this place and enter the territory that was formerly Prester John's.

"Tenduc is a province which lies towards the east, and contains numerous towns and villages; among which is the chief city, also called Tenduc. The King of the province is of the lineage of Prester John, George by name, and he holds the land under the Great Kaan. . . . .

"Here also is what we call the country of Gog and Magog, they, however, call it Ung and Mungul, after the names of the two races of people that existed in that Province before the migration of the Tartars."

Marco Polo's exact route is uncertain but from the names of the several cities he mentions we may reconstruct something of his path. The site of Erguiul is unknown, but from Marco's earlier itinerary it probably lay near Liangchow, an important city on the great highroad to Chinese Turkestan which skirts the southern borders of the Alashan Desert. The city of Calachan is undoubtedly the modern Wangyehfu, often known locally as Alasha, or Alashar, still famous for the manufacture of rugs and cloth of camel and sheep wool. Ergrigaia is the large city of Ningsia, called Irgai by the Mongols. The word Tangut applies to the area west of the Hwang Ho, both in Mongolia and around Koko Nor, once ruled by the Western Hsia Kingdom.

From Ningsia, Marco Polo continued eastward across the Ordos, either directly by way of Dabasun Nor, or around the bend of the river. The region of Tenduc corresponds with the Kweihwacheng plain, and Rockhill has identified the deserted ruins near Tokoto as the site of the former city of Tenduc. The reference to Gog and Magog is obscure, but Yule considers that it is an allusion to the Great Wall which lies just south of this region.

Russian Work

Within modern times, Russian and French travellers have led the way in exploring and describing the Ordos. The Russian expeditions have been a result of Russia's interests in Outer Mongolia, while the travels of the French have been stimulated by their missionary work. Unfortunately much of the Russian material is available only in that language and has been known to most students only through brief reviews in French, German or English periodicals. The writer has been able to have rough translations prepared of the principal contributions for use in the present paper.

For three centuries Russian merchants and political representatives have had dealings at Kweihwacheng, the city from which the tea caravans started across Mongolia to Siberia. The first European who visited the town and used the present name was the Russian ambassador Baikoff in 1654. The earliest and one of the foremost explorers of Mongolia was Prejevalsky (*49*). In 1871 and 1872 he mapped the valley of the Hwang Ho from Kweihwa to Ningsia, and collected information for all of the Ordos Desert and its encircling mountains. He was followed in 1884 by Potanin (*50*) who explored the eastern and southern Ordos in the vicinity of the Great Wall. V. A. Obruchev (*51*) was the third of the Russian travellers and is probably the most important authority on the Ordos. In 1893 he crossed the western part of the desert from Santaoho to Siaochiaopan, and on another expedition studied all of the southern Ordos. In his numerous articles he has given the most complete account of the desert as a whole, especially in its physical aspects. The various journeys of Kozloff (*52*) commencing in 1899 and continuing in the present century did not extend farther east then the Holan Shan, but his studies of these mountains are of value in an understanding of the Ordos. Chermos (*53*), the most recent Russian explorer, encircled the Arbus Ula and crossed the Holan Shan in 1908.

French Explorers

The earliest of the French travellers was Father Gerbellion (*54*) who in 1688 passed through the eastern and southern Ordos in company with the Emperor Kang Hsi. A century and a half later two other French priests, Huc and Gabet (*55*), travelled through the northern and western Ordos, and their account of life in Mongolia remains today one of the finest bits of pictorial description ever written of interior Asia. Their route led from Kweihwacheng southwest to the Hwang Ho and thence by way of Dabasun Nor to Shihtsuitze, Ningsia and Chungwei. Huc's account, though especially valuable for the life of the people and the general aspect of the country, lacks precise geographic description. Armond David (*56*), the next French explorer, travelled in 1866 in the northeast. He was followed by Bonin (*57*) in

1896 who crossed the Ordos from east to west. The last traveller who has visited Genghiz' tomb at Edchin Koro and the central Ordos was De Lesdain (*58*) who in 1904 crossed from Kweihwacheng to Ningsia by a new route. Since the close of the nineteenth century, French and Belgian mission stations have been located in the Ordos, and occasional articles on the region have been written by the Fathers (*59*). The chief mission is the Congregation de Scheut of Belgium at Santaoho. Other Catholic stations are at Kweihwacheng, Chabernor, Siaonor, Ershihszekingti, Siaochiao, Ningtiaoliang, and Ningsia. Various Protestant organizations have missionaries at Kweihwacheng, Saratsi, Paotowchen and Ningsia.

Other Travellers

The American Minister to China, Rockhill (*60*), passed through the northern and western Ordos on his way to Tibet in 1891, and his diary is one of the most valuable sources of information on the people and the nature of the country. The list of explorers who have penetrated the central Ordos within the twentieth century is quite brief. Numerous travellers have followed the river between Kweihwacheng and Chungwei, or the caravan road which lies near the left bank, and several have taken the shorter route which connects Paotowchen and Shihtsuitze by way of Dabasun Nor. Among the latter was Pereira (*61*), who crossed in 1911.

The most valuable contribution to the cartography of the Ordos is that made by Tafel (*62*), the German explorer, who led an expedition along the valley of the Hwang Ho between Shensi and Shansi from Tungkwan north to Kweihwacheng, and Paotowchen, thence southward to Yulin, and from there westward to Ningsia and Chungwei. Tafel's route maps, on a scale of 1:200,000 are the only plane-table surveys of the area.

Geological studies of the margins of the Ordos have been carried on by Wong Wen-hao of the National Geological Survey of China, C. C. Wang (*63*), also of the Survey, Teilhard de Chardin and E. Licent (*64*), and Fuller and Clapp (*65*) all of whose reports have been published within the past decade.

In 1924 Cressey travelled through the southern Ordos enroute to Tibet, returning through the Alashan Desert to Ningsia and thence by way of the Hwang Ho to Paotowchen and Kweihwacheng. A second expedition, in 1928, on which it was planned to penetrate the unknown central area from the north, was partially frustrated by brigands who have been active during recent years in the northern valley of the Hwang Ho.

In addition to these explorers, many of whom have left route maps, mention should be made of the Military Map of Suiyuan, prepared by the General Staff of the Chinese Army in 1914. This map is published on a scale of 1:100,000 and is issued in 182 sheets. It apparently represents a rough reconaissance rather than a survey, but shows trails, salt lakes, monasteries, the various banners, and boundaries.

Despite the work of the past century, a large amount of exploration still remains to be done before the cartography, geology or human possibilities are properly known. In that part of the desert enclosed with the Hwang Ho are several areas thousands of square miles in extent which have never been described, much less mapped. Any generalizations as to the character or future of the Ordos must remain uncertain until these regions are known.

7. THE MONGOLS, SHEPHERDS OF THE OPEN STEPPE

Nomadism

Central Asia is the land of the nomad. In these vast arid plains vegetation is restricted to dry grasses and a limited group of xerophytic plants. Enveloped in aridity, the Mongols have adjusted themselves to a pastoral existence wherein the whole economy of life is dependent on grass. On it their flocks of sheep, cattle, horses or camels feed, and from these animals they derive their food, shelter, clothing, fuel, transportation and wealth. With ample grass, there is prosperity and health; without it, adversity. Since the grass is too short to be cut, there is no possibility of storage.

Grass depends on climate. All life is thus intimately related to

a capricious environment. Small wonder then that the salutation between travellers includes an inquiry as to whether one has seen rain falling during his journey, or whether he has passed through green pastures (Fig. 14).

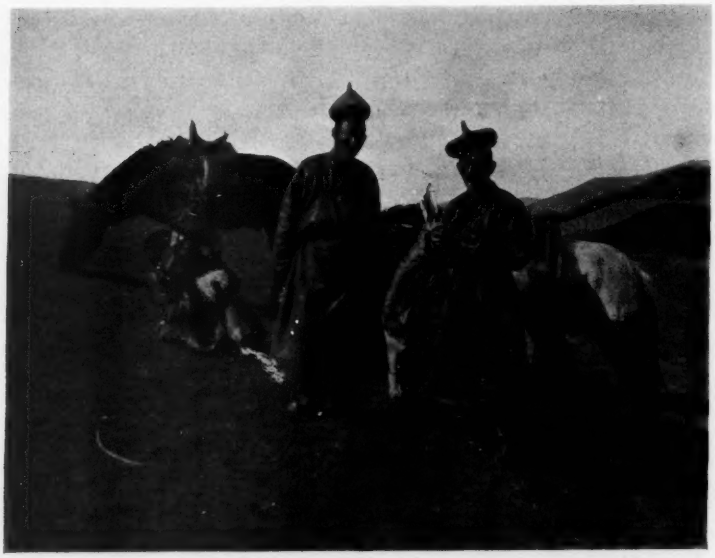

FIG. 14. MONGOLIAN HORSEMEN NEAR THE SIBERIAN BORDER

Although taken outside the Ordos, the illustration represents well conditions in the better parts of the Ordos before agriculturalists pressed the nomads out of the richer grass lands.

Abbe Huc (*66*) has graphically described the migratory nature of this quest for grass:

"You sometimes in Tartary come upon plains more animated than those you have just traversed; they are those, whither the greater supply of water and the choicest pastures have attracted for a time a number of nomadic families. There you see rising in all directions tents of various dimensions, looking like balloons newly inflated, and just about to take their flight into the air. Children, with a sort of hod at their backs, run about collecting *argols*, which they pile up in heaps around their respective tents. The matrons look after the calves, make tea in the open air, or prepare milk in various ways; the men, mounted on fiery horses,

and armed with a long pole, gallop about, guiding to the best pastures the great herds of cattle which undulate, in the distance all around, like waves of the sea.

"All of a sudden, these pictures, so full of animation, disappear, and you see nothing of that which of late was so full of life. Men, tents, herds, all have vanished in the twinkling of an eye. You merely see in the desert heaps of embers, half extinguished fires, and a few bones, of which birds of prey are disputing the possession. Such are the sole vestiges which announce that a Mongol tribe has just passed that way. If you ask the reason of these abrupt migrations, it is simply this: the animals having devoured all the grass that grew in the vicinity,

FIG. 15. FELT-COVERED YURT, TYPICAL HOME OF THE NOMAD

Cloth tents are used occasionally while traveling. The sheet-iron stove is for burning argol.

the chief has given the signal for departure; and all the shepherds, folding their tents, had driven their herds before them, and proceeded, no matter whither, in search of fresh fields and pastures new" (Fig. 15).

Considerable portions of the Gobi, Alashan, and Ordos Desert are too dry for permanent pastoral occupation. A few wandering shepherds venture into them after the summer rains, but the chance distribution of rainfall makes the location of the pastures shift from year to year. Within the deserts, however, are

scattered basins known as tsaidams in some localities, gobis in others, where ground water lies near the surface and fairly dependable pasture grows. These isolated areas from oases in the midst of the true desert. Though they are numerous, they have little capacity to support life. The real home of the nomad is in the belt of grass land or steppe, encircling the more barren desert, where the rainfall is somewhat more abundant (Fig. 16).

FIG. 16. A WELL IN THE GOBI DESERT
(Photograph from the American Museum of Natural History)

Along the northern margin of China proper, in the vicinity of the Great Wall, is a zone of steppe or prairie known as the *tsao ti* or land of grass. This belt, where the grasses are principally of the shorter varieties, extends from Manchuria to Tibet varying in width from several tens of miles to a few hundred miles. Where it crosses the eastern Ordos this grass land extends from the northeast to the southwest; the steppe includes the plain of the Hwang Ho from Kweihwacheng to Paotowchen, some fifty miles wide outside the Great Wall, and in the southwest the area around Ningsia and south nearly to the 37th parallel within the present

line of the Great Wall. The still drier district of Wuyuan lies in the northwest and is intermediate between steppe and desert.

All of the Ordos and surrounding region, with the possible exception of the southwest for which the historical records are incomplete, has been the home of the nomad at some time in the past. The steady pressure of the Chinese agriculturalist has now pushed the Mongols out of the more favorable grazing grounds into the interior Ordos, so that they now occupy no area within the Great Wall. The Kweihwa and Ningsia areas are both completely Chinese, and only in the north central and western portions of the area is there any nomadism along the left bank of the Hwang Ho. The bulk of the Mongols now live in the relatively more humid eastern half. Some have been so affected by the penetration of Chinese culture that they have abandoned their yurts and now live in Chinese-style mud houses and wear Chinese dress.

Tribal Organization

The Mongols were originally a nomadic people in the fullest sense, but for many centuries the various tribal organizations have been restricted to definite areas and even the individual nomadic families have only two or three grazing localities each year. The general organization built up under Genghiz Khan and his successors was taken over and modified by the Manchus when they conquered China (*67*). The Manchus created many new divisions in order to weaken the Mongol organization and increased their own control through titles conferred upon minor rulers. The basis of the present organization is the millitary rank or position in battle occupied by each unit. The smallest groups are known as banners or *hoshung*, and these are grouped into tribes or *aimaks*. Several *aimaks* make up a league. In all of Mongolia there are several hundred banners, and the organization is by no means uniform. The Mongols of the Ordos region are divided into three groups. The Toumets of Kukukhoto, as Kweihwacheng is known to the Mongols, form an *aimak* which is divided into the left and right wing. The Toumets still own a considerable part of the Kweihwacheng plain and are supposed

to receive a nominal rental for the site of the city, but they have largely abandoned their wandering life and most of them live as do the Chinese. West and north of Paotowchen lies the territory of the Orat who are known to the Chinese as the Wula Mongols. Little is known of their origin or distribution, but they are divided into the eastern, western and middle dukedoms. The Orats appear to be Kalmucks who came from the west about 1686. The palace of the Hsi Kung, or Western Duke, is located some 50 miles westward from Paotowchen. The exact location of the other clans and their present importance is unknown, but they are distributed in the northern valley of the Hwang Ho.

Most of the Mongols of the Ordos Desert belong to the Ikh Chao or Ordos tribe, which is composed of seven banners. This tribe had the special duty of protecting the encampment or *ordu* of Genghiz Khan, and from this responsibility they received their general name. The banners of the Ordos are Talat, Djungar, Wang, Djassak, Wushun, Ottok, and Hangkin. Djassak was founded in 1731, and the others date back at least as far as 1649 when the region was conquered by the Manchus. At the head of each banner is a prince, one of whom serves as the head of the *aimak*.

The prince of each banner has a residence built in Chinese style which might be called a palace, usually enclosed within a walled fortress. The area under the control of each *hoshung* is approximately defined, but no maps are available to indicate the boundaries. Aside from the newly established Chinese hsien city of Tungsheng in the east central Ordos and the in village of Ningtiaoliang along the highway to Ningsia in the extreme south, there are no towns or village settlements in the area between the Great Wall and the Hwang Ho. The palaces of the princes and the numerous lamaseries constitute the only fixed points of Mongol concentration, and even here there are seldom shops or stores. Although the feudal authority is concentrated in the princes, the lamas exercise such an absolute spiritual dominance that they are in fact the real rulers. To them the people look for guidance in all the details of life, both social and civil (Fig. 17).

The easternmost of the banners is that of Djungar, which for-

merly controlled the southern Kweihwacheng plain. By land purchase and through military force the Chinese have pushed the banner across the Hwang Ho, and the palace of the prince is now southwest of Tokoto. Directly southward from Paotowchen and just beyond the limit of cultivation along the river lies the palace of the Talat banner, sometimes written Talde. In the east central Ordos are three *hoshung* whose headquarters are not

FIG. 17. MONGOL WOMEN IN THE NORTHWESTERN ORDOS GATHERED FOR A TEMPLE FAIR

far from each other: Wang, Djassak and Wushun. Each of these formerly occupied a larger area than at present, but all have lost their eastern grazing grounds to the oncoming Chinese farmers. The greater aridity and consequent poorer pasturage westward is indicated by the fact that two banners, Ottok and Hangkin, together occupy more than half of the entire Ordos. The left bank of the Hwang Ho between the Alashan Range and the Karanarin Ula is in part under the control of Ottok, but it is also used by the banners of the Alashan Desert.

Lamaism

No picture of Mongol life is complete without some consideration of lamaism. This variety of buddhism, of Tibetan origin, holds complete domination over the peoples of Mongolia. At least one son from each family, commonly the eldest, must become a lama, often being sent to the monastery while yet a child. The number of lamas, where known, thus constitutes one of the

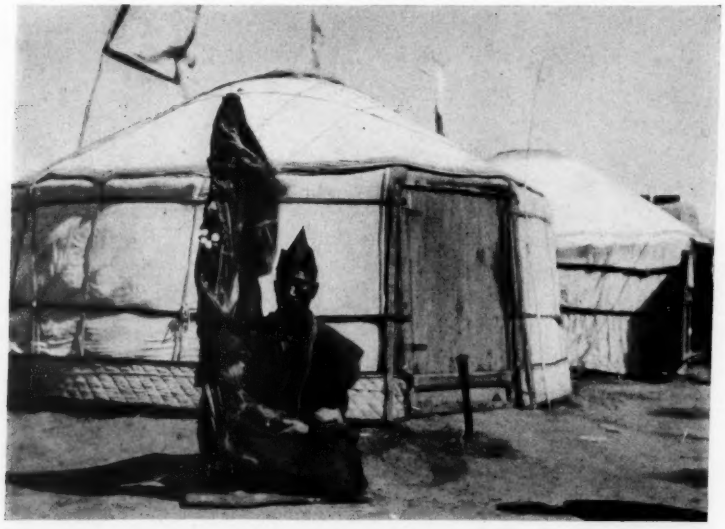

FIG. 18. YURTS EMPLOYED AS LAMASERIES
The lama priest is holding prayer flags and ritualistic emblems

best available indices to the total population. The monasteries range in size from those which have but a score of lamas to the largest which may list a thousand monks, as in the case of Wutaichiao in the Taching Shan, 50 miles north of Saratsi. The Chinese Millitary Map of Suiyuan shows 38 of these lamasaries and fails to list several known to exist, particularly in the mountains to the north and west. The entire number in both the Ordos itself and in the encircling mountains may well approach 50.

The lama temples are substantial structures, commonly built in a mixture of Tibetan and Chinese architecture with massive white walls and gilded roof. Many of them rise from two to four stories in height, elaborately decorated both within and without (Fig. 19). These temples are not only the centers of religious exercises, but are the seats of learning as well. Few Mongols except the lamas can read or write, so that the monks serve as letter writers. Some lamas likewise serve as lawyers or doctors.

FIG. 19. LAMA MONASTERY WEST OF PASTOW

The walls are of Tibetan architecture, but the roof is essentially Chinese. (Photograph from the China International Famine Relief Commission.)

The larger lamaseries which possess original copies of the writings of the early disciples usually have printing equipment. In the more important monasteries are usually a few lamas who spend part of their time as artisans making brass ware or other objects, principally those used in worship in the temples or in the homes. While these and other auxiliary occupations are found in numerous instances, most of the lamas live an idle and degenerate life, their sole occupation being the protracted incantations connected with their faith. Only a few are really scholars,

and such acquaintance with the precepts of lamaism as most of the priests possess is acquired through memorizing the canons.

While lamaism results in the withdrawal of a considerable proportion of the able-bodied men from productive work, it does serve as a more or less effective check on population increase, for the lamas, in theory at least, are celibate. If the population were not thus kept within bounds, it would soon exceed the limited food producing capacity of the land. Thus even in their religion the Mongols have made adjustments, unconsciously perhaps, to the restrictions imposed by their environment.

Water Supplies

One of the most serious problems of life in the desert is the scarcity of water. There are no dependable rivers except the Hwang Ho, and springs are few and unreliable. Water is commonly obtained from wells which range in depth from a few feet in the lower depressions to a hundred or more on the level plains. Some wells are reported to be 18 to 20 *chang*, or about 180 to 200 feet deep, and Prejevalsky (*68*) refers to a well 350 feet deep in a ruined city built by Genghiz Khan in the northwestern Ordos. Most wells are a few tens of feet deep and are revetted with stones or sticks. These wells are usually spaced about a days journey apart along the various trails, and are the centers for watering the flocks of the district.

By far the greater part of the Ordos is treeless, across which one may look to the horizon without seeing anything but sand or grass and low brush. A dwarfed willow grows in the northwest near the Hwang Ho, but nowhere is there any wood suitable for construction purposes. All lumber needed for saddles, carts, chests, or houses must thus be brought in from the outside world, so that its use is kept at a minimum. The Mongols are poor workmen, and most articles are made by Chinese carpenters who sell them at the occasional temple fairs.

Shelter

The typical home of the Ordos Mongols is the yurt, the felt covered tent used by the nomad throughout inner Asia. It is

made of a circular lattice framework of light willow sticks which are jointed so as to fold. The frame is from 3 to 4 feet high and 12 to 15 feet in diameter, above which a circle of sticks arches upward and meets in the center like the spokes of an umbrella. The height of the yurts varies, but the center is seldom much higher than a man's head. Over the framework are placed layers of felt made from sheep's wool, the number of layers depending upon

FIG. 20. MUD HOUSES USED BY MONGOLS WHO HAVE ABANDONED NOMADIC LIFE FOR AGRICULTURE

The room at the left was occupied by nine people when the picture was taken, while the other rooms housed a few pigs, sheep and cattle.

the severity of the weather. At an hour's notice the felts and framework can be folded and placed on a cart or camel. No windows lighten the interior but at one side is a low wooden door through which one must stoop to enter. Except when it is too cold, a corner of one of the felts is thrown back from the roof to provide an outlet for the smoke from the cooking fire. Since the yurts are small and relatively wind proof, they retain such

heat as may be derived from the cooking or from the occupants. Their shape, furthermore, gives them strength against the winter gales. During the summer months, the felts are sometimes replaced by reed mats.

In addition to the yurts, the Mongols frequently use tents of blue cloth during the summer or when they are traveling. The tents are supported by poles at the end and along the ridge, and the cloth slopes to the ground in a concave curve, thus giving the wind no purchase. When new, the tents are decorated in blue and white with various symbolic designs, but they fade rather quickly.

Where the Mongols have abandoned nomadism or have constructed lamaseries or tribal headquarters they use wood only in roof beams, window frames and doors. The walls are built of pounded earth or sun-dried bricks, and the roofs are of mud, spread over brush or reeds, or, in the more pretentious structures, of gray tile (Fig. 20).

Food

The food of the nomad shepherd represents a similar adjustment to the limited offerings of nature. The Mongol is a horseman, and traditionally disdains cultivation. The Chinese farmers of the border lands consider the Mongol stupid because he will not cultivate the soil, but they fail to appreciate the climatic difficulties and limitations of agriculture in the dry steppe where he lives. Once the protective covering of the natural vegetation is destroyed or the half-cemented surface crust, so common in regions of excessive evaporation, is plowed, the soil is lifted by the wind and carried away in clouds. Whether through the wisdom of experience or through laziness, the Mongol has refrained from agriculture, and depends for his livelihood on the products of his flocks and of the chase.

The richest grazing grounds in southern Mongolia have now been largely taken over by the Chinese, with results to be discussed in the following section. Almost nowhere within a hundred miles of the Great Wall is it today possible to see large flocks of sheep and cattle grazing on rich pastures such as described by travellers 75 years ago. The Mongols of the Ordos are now dependent upon

a limited and poor grazing area. Little wide-ranging nomadism remains, and the pastoral activities are now largely carried on from more or less semi-permanent bases.

Sheep and goats are the most numerous animals, but cattle, camels and ponies are also raised Milk is obtained from all, although not so commonly from camels or mares. Milk forms the basis of Mongolian diet, but is seldom drunk fresh. The scarcity of water makes it difficult to clean the utensils used, and in dirty containers the milk sours quickly. This is not entirely a disadvantage, for where large quantities of milk must be consumed it is better drunk sour. Milk is seldom drunk separately, but is used in tea or made into butter or cheese.

In addition to milk products the chief articles of food are mutton, brick tea, and parched millet. The second and third are brought in from the outside world. The tea, of various grades, is prepared in Hankow, most of it being of poor quality and mixed with tea dust and twigs. It is compressed into bricks weighing about two and a half pounds from which the tea is shaved as desired. The bricks of tea form a common article of trade, and are frequently used as the currency of the desert.

The standard fare of central Asia is a milk tea, drunk from the borders of Manchuria to the Caspian Sea. It is a steaming hot, grayish colored beverage of sour milk, tea shavings, butter which is usually rancid, and salt. Often a handful of parched millet is added, or in Tibet *tsamba* or parched barley, and sometimes dried cheese. Thus prepared the tea forms a gruel which is the *piece de resistance* of every meal. Unpalatable as such a concoction seems, it is both nourishing and good, at least when well made, as the writer is willing to testify. Through experience, the Mongols have learned that only those who drink their tea as hot as possible escape dysentery and cholera. It is drunk from small wooden bowls because a chinaware cup would be uncomfortably hot to handle, and would be easily broken in the movements of the nomad. The bowls are so designed that they may be easily licked clean thus avoiding the necessity for water. Every traveller carries his own bowl within the folds of his robe. In those areas where there is considerable contact with the Chinese, wheat flour

is sometimes used, either boiled as noodles or baked in small cakes.

Fuel

Lack of fuel constitutes a serious problem in the preparation of food. Brush, reeds, and straw are used where available, but the common fuel of the desert is the dried dung of the cattle or camels known as *argol*. The collection of the dung is a time-consuming task usually entrusted to the women or children. Near the yurts are sure to be heaps of *argol*, and if the camp is semi-permanent the piles may bulk larger than the yurts themselves. When the nomads are travelling they start collecting dung an hour or more before they halt so that there may be enough fuel for cooking the meal. In districts away from the main trails or more commonly used grazing grounds, the collection of enough *argol* is often a serious problem. Even when completely dry, *argol* is not a good fuel. It gives off pungent fumes, and when burned within a closed yurt, the acrid smoke becomes particularly trying on the eyes of one not accustomed to it.

The possibilities of cooking with *argol* are limited because it is scarce and heats poorly. At an elevation of 4000 feet the boiling point of water is lowered to 204°F., so that it is difficult to cook food thoroughly. Cooking is commonly done in a brass or copper dish, closely covered, supported on three stones or an iron standard. Tea is served from tall wooden pots. When mutton is eaten, it is placed on a common platter, from which each person cuts off portions with his belt knife. Spoons and chopsticks are sometimes used, but fingers serve in most cases. In the large lamaseries where food is prepared in a common kitchen for several hundred lamas tea is made in huge caldrons, often four feet in diameter. Three such caldrons seen by the writer in the monastery of Kumbum, on the borders of Tibet, were ten feet in diameter and five feet deep.

Clothing

The dress of the Mongols is a further example of geographic influence. They use sheepskins and felt extensively. Cotton

cloth, purchased from Chinese merchants, is also used considerably. A dark purple or blue is the favorite color among the men, while the women dress in maroon, purple, blue or dark green. Both men and women wear long gowns or cloaks lined with fur or sheepskin and tied around the waist with a sash, with sleeves extending beyond the hands to take the place of gloves. Such a one piece garment keeps out the chilly winds of winter. Boots are thick and heavy, designed to keep the feet warm when on

FIG. 21. MONGOLIAN JEWELRY OF SILVER, TURQUOISE AND CORAL

horseback. The boots are made of leather or felt, and are so stiff that the Mongol appears to hobble when on foot, especially since the many hours in the saddle make him bow-legged. When ever possible the Mongol rides, for he is most at home in the saddle. The clothes worn on festival days or gala occasions tend to approximate those worn by the Chinese; on such occasions silks are customary. In the process of "Chineseification" now so rapidly in progress in the eastern Ordos, it is distinctly noticeable that the women cling to their traditional dress and customs much

longer than the men. The lamas, however, are most conservative and retain their traditional dress and habits.

A man's wealth is estimated by the size of his herds and by his wife's jewelry. These are the only ways of accumulating wealth, for there are no banks or currency, and land is held in common. The ornaments worn by the women vary in each section of Mongolia, but usually consist of earrings, necklaces, and articles worn in connection with the elaborate hairdressing (Fig. 21). Coral, turquoise, and silver are favorite materials. Each yurt contains a chest or two for such treasures.

Since the opening of the present century, and particularly since the construction of the Peiping-Suiyuan Railroad two decades ago, Mongolia has become an important source of wool, hides, and furs for the world market. Paotowchen, Kweihwacheng, and Kalgan are the chief collecting centers for southern Mongolia, some of the wool even coming by caravan from Sinkiang. This export market has changed the economy of life for the nomads of the desert, giving them a cash market where formerly they lived out of economic touch with the rest of the world.

Geographic Adjustments

The material life of the Mongols is an excellent illustration of man's adjustment to a distinctive geographic environment. Few peoples live in a region of such limited resources as these desert nomads. The possibilities of occupation, shelter, food, fuel, and clothing are all laid down by nature. Their one resource is an uncertain supply of short dry grass, so limited as to be unusuable directly by man. Through the intermediary of their flocks they transform this grass into the various essentials of their life, or into commodities such as wool or hides with which they may purchase things from the outside world. Not only in the field of things, but also in the realm of ideas and beliefs the Mongols reflect their environment.

The Ordos is no place for the weakling. Generations of life in these exacting wastes have produced a race of vigorous men and women to whom the hardships of heat and cold, hunger and privation, and long hours on horse or camel back are but the com-

mon-place of life. So long as they keep to their open life they are healthy and happy. When they settle down and attempt to adopt the life of the Chinese agriculturist they deteriorate to a marked degree, both physically and morally. Central Asia has few sadder pictures than those presented by the Mongols, and Tibetans too, who have given up the life of the open steppe and have succumbed to the penetration of Chinese culture which, totally irrespective of its value to the Chinese themselves, has brought only sickness and laziness to the nomad. The Mongolian race seems to have lost its ability to adjust itself to new situations.

The life of old Mongolia is passing. Especially in the Ordos the days of dashing horsemen mounted on fiery steeds watching over huge flocks of sheep or cattle is about over. The days of the great Khans when the very name of the Mongols spread terror from the shores of the Baltic to the coasts of Annam are gone, and the present trend of history makes it unlikely that they will ever return. Bereft of their best grazing grounds the Mongols are hardly likely ever again to play an important rôle in world affairs.

8. THE SONS OF HAN IN THE LAND OF GRASS

The Pioneer Fringe

The boundary zone between the agricultural Sons of Han and the pastoral descendants of Genghiz Khan has never remained fixed. With vicissitudes of climate and varying strength or weakness of one people or another, it has shifted to the north or south. The Great Wall was built to keep out the nomads of the desert, but during half of the past 1500 years, it has failed to do so and China has been ruled by Tartar dynasties. At other times, as for example during the height of the Ming Dynasty, effective Chinese occupation extended to the southern margin of the Gobi Desert. The present advance of the Chinese farmer is but another of these movements, destined perhaps to be more permanent because of the knowledge of scientific agriculture soon to be available, but none the less directly dependent upon climate and subject to its dictates.

The Great Wall is more than a political line. For much of its course it follows a major physiographic boundary which separates the plateau of Mongolia from the lower lands of old China. It likewise marks a climatic transition, dividing the lands to the south which receive their rainfall from the monsoon winds from those to the north which are distinctly semi-arid. The Wall likewise roughly marks the limit of interior drainage, for although

FIG. 22. WALLS OF AN ABANDONED FARM ESTABLISHMENT SOUTH OF TINGPIEN

the Hwang Ho swings outside the Wall, it receives scarcely a single tributary from the Ordos. Furthermore, the Great Wall locates a major change in potential land use; the transition from cultivation to grazing. North of the Wall are occasional steppe lands with rich grasses and even scattered forests in the mountains, but in general agriculture is only possible under special conditions and with considerably increased risk of failure as compared with the lands to the south.

The absolute desertward limit of possible agriculture will de-

pend upon varying factors such as improved agricultural methods, cheap transportation, market price, the economic availability of machinery and power for use on the farms, fluctuations in both time and amount of the rainfall, and standards of living which the people will accept. Any change in one of these elements will bring an advance or retreat of the desert margin of cultivation and will change the prosperity of the entire zone (Fig. 22). Settlement in the marginal pioneer regions will inevitably be attended with uncertainty (*69*) (Fig. 23).

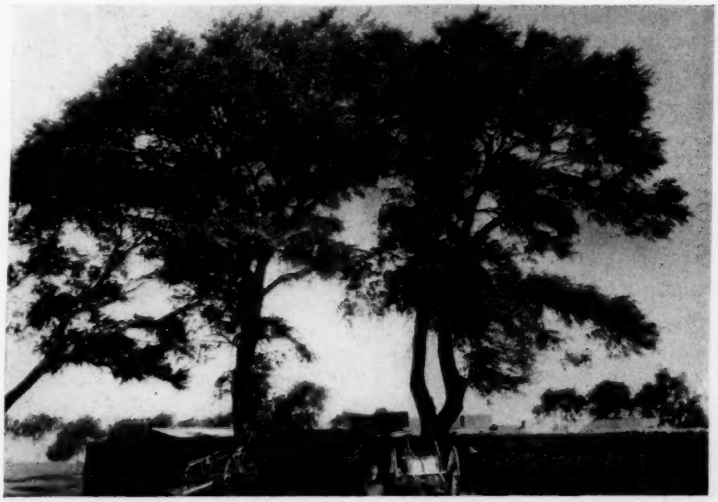

FIG. 23. TREES UNUSUALLY LARGE FOR THE DISTRICT, NORTH OF CHINGPIEN

Agriculture

The climate of the area is sharply continental. There is considerable variation in the time of the summer rainy season and the light spring rains often fall so late that plowing cannot be started in time for crops to mature before the early fall frosts. In order to conserve soil moisture by decreasing evaporation, the surface of cultivated fields are usually kept pulverized. In the

outer areas nearer the desert there is usually not enough rain to permit crops to be grown each year, so that fields are allowed to lie fallow every other season or in some cases two years out of three. The growing season seldom exceeds 100 days.

The virgin soil generally does not retain its productivity for more than six to eight years without fertilization. Since the pioneer farmers have no dairy cattle and only two or three draft animals, there is a shortage of manure, and what dung is available is largely used for fuel. Harvests, consequently, become smaller and smaller. In the irrigated regions along the Hwang Ho where moisture is brought to the surface and evaporated, salts accumulate on the surface to excess and render the soil unfit for cultivation.

The penetration of the Chinese agriculturist into these desert borderlands has not been without its disastrous effects. The following quotation from Huc (*70*), written in 1847, graphically describes some of the consequences in the region to the east of Kalgan which also applies to a considerable degree in the Ordos.

"Towards the middle of the seventeenth century, the Chinese began to penetrate into this district. At that period, the whole landscape was still one of rude grandeur; the mountains were covered with fine forests, and the Mongol tents whitened the valleys, amid rich pasturages. For a very modest sum, the Chinese obtained permission to cultivate the desert, and as cultivation advanced, the Mongols were obliged to retreat, conducting their flocks and herds elsewhere.

"From that time forth, the aspect of the country became entirely changed. All the trees were grubbed up, the forests disappeared from the hills, the prairies were cleared by means of fire, and the new cultivators set busily to work in exhausting the fecundity of the soil. Almost the entire region is now in the hands of the Chinese, and it is probably to their system of devastation that we must attribute the extreme irregularity of the seasons which now desolate this unhappy land. Droughts are of almost annual occurrence, the spring winds setting in, dry up the soil; the heavens assume a sinister aspect, and the unfortunate population await, in utter terror, the manifestation of some terrible calamity; the winds by degrees redouble their violence, and sometimes continue to blow far into the summer months. Then the dust rises in clouds, the atmosphere becomes thick and dark; and often, at mid-day, you are environed with the terrors of night, or rather, with an intense and almost palpable blackness, a thousand times more fearful than the most sombre night. Next after these hurricanes comes the rain: but so comes, that instead of being an object of desire, it is an object of dread, for it pours down in furious raging torrents. Sometimes the heavens, suddenly opening, pour forth in, as it were, an immense cascade, all the water with which they are charged in that quarter; and immediately the fields and their crops disappear

under a sea of mud, whose enormous waves follow the course of the valleys, and carry everything before them. The torrent rushes on, and in a few hours, the earth reappears, but the crops are gone, and worse even than that, the arable soil also has gone with them. Nothing remains but a ramification of ruts, filled with gravel, and thenceforward incapable of being plowed."

While Huc's conception of the relation between deforestation and rainfall is open to question, there can be no doubt that the cultivation of these marginal lands has greatly increased wind work and slope erosion. An example may be seen in the southern Ordos where the land was originally covered with a sparse growth of grass and low brush. Within the memory of Belgian priests living in this area, Chinese colonists have attempted to cultivate the soil. The result has been that as soon as protecting vegetation was destroyed, the strong winds began to erode the soil and have piled up great sand dunes which now cover hundreds of square miles. Cultivation in this region is now declining and the remaining farms are continually in danger of being engulfed by wandering dunes. Too often the object of the Chinese farmer has been merely to produce enough food to nourish his family at the moment, rather than to increase the productivity of his fields or to look ahead to the future.

Colonization

The present colonization movement has been in progress longer in eastern Inner Mongolia in proximity to the crowded plains of China than in the Ordos. Huc's description of the country to the north of Peiping, just quoted, refers to the seventeenth century whereas Rockhill (*71*) places the date for the occupation of the eastern Ordos as later than 1860. At no time or place has there been any wave of migration similar to that which invaded Manchuria prior to 1931. At times of trouble south of the Wall, as during the Mohammedan Rebellion of 1861–78, many Chinese have sought security by moving out into the grass lands. At other periods, the mere pressure of population in Shansi and Shensi has led people to seek their fortune as pioneers in these new lands. On the other hand, drought has often driven people back from newly occupied regions, or bandits and disorganized soldiers have laid waste the pioneer belts.

The penetration of the Chinese has been aided in many cases by the degeneracy of the Mongol princes, many of whom have residences in Peiping where they have settled down to a life of pleasure and have sold the rights of colonization to speculators without the knowledge of their tribesmen. No statistics are available as to the number of immigrants to these areas or as to the extent of the land now under cultivation outside the Great Wall.

Living Conditions

The standard of living of the Chinese farmers of the Ordos is low. The houses are of sun-dried mud bricks or of pounded earth, with a mud roof laid over a mattress of reeds or brush supported on willow poles (Fig. 24). There are usually two rooms, one with a crude mud stove with a single circular opening for the large iron pan in which all cooking is done, and the other with a raised platform or *kang* which serves as a bed and through which circulates the smoke from the adjoining stove. Wood is scarce and its use is restricted to the roof beams, doors, and windows. Such a house may be built for the cost of the wood and a few days labor. A few simple dishes and jars for food, together with bedding and a chest for extra clothing and supplies, complete the necessary equipment.

Farm animals usually include a team of mules or oxen, a riding donkey, a pig or two, a dozen chickens, and one or more mongrel dogs. The animals are kept in a mud structure similar to the house and often adjoining it, and the court-yard is surrounded by a mud wall. In regions where protection is necessary, several families, usually from the same ancestral village, build their houses together and erect a veritable fortress with walls ten to twenty feet high. Stones may be placed around the parapet to throw down on bandits.

Some of the farms are large by Chinese standards, but they seldom exceed 300 acres, and the average in the irrigated areas is less than one-tenth of that figure. The price of the land varies with its location and fertility, new land costing from Mex. $2.00

to $5.00 per mow. If water is available for irrigation, the cost may be much greater.

Along the course of the Hwang Ho in its northward bend through the Ordos are several areas where irrigation canals have been constructed along the left bank, principally in the vicinity of Chungwei, Ningsia, Santaoho, Wuyuan, and Saratsi. No canals

FIG. 24. TYPICAL MUD HOUSES OF CHINESE AGRICULTURISTS

Due to drought and bandit raids, only fifteen per cent of the houses south of Paotowchen were occupied in 1928.

are in use along the right bank except in the extreme southwest, although the writer found abandoned and grassgrown ditches in the extreme northwest in 1924 and south of Paotowchen in 1928. Except at Saratsi, there are no check gates at the intakes, so that the canals tend to fill up rapidly with river silt if neglected. Many of the canals shown on most maps, especially in the Wuyuan area, are so silted as to be no longer usable.

Ningsia

The oldest irrigation works in the Ordos are those around Ningsia. The first canal in this area was dug during the Han Dynasty, 2000 years ago, while others date back to Tang and Ming times. Several of the canals in the region are 30 to 40 feet wide and resemble small rivers. Similar irrigation canals have been constructed near Chungwei, while smaller ones encircle Ningan, Ningling, and Lingchow. The canals have transformed their respective areas into productive oases which stand out bright green in an otherwise parched and brown landscape. Many are lined with willows or poplars which furnish a timber supply for houses and boats. In addition to wheat, millet and rice, the oasis raises delicious apricots, peaches, and melons. Not all the land served by these canals is under cultivation. Not infrequently desert conditions extend almost to the banks of the canals on both sides. Elsewhere the ditches have become so filled with sediment that they seldom carry water. In places the soil is sandy or alkaline, and there are several swamp areas, particularly to the east of Ningsia, due to the uncontrolled overflow of the canals. Little effort is made to raise crops upon unirrigated land. The Ningsia oasis is the largest of these areas and extends from opposite Ningling north nearly to Shihtsuitze, a distance of about 85 miles. No reclamation projects or colonization movements are in progress in any of these regions.

The city of Ningsia (Fig. 25), under different names and occupied by different races, has existed continuously for at least twenty centuries and has had a troubled history, having been sacked and rebuilt half a dozen times. Marco Polo called the city Egrigaia, and the Mongols today speak of it as Irgai. In addition to being the focus point of the irrigated oasis between the Hwang Ho and the Alashan, Ningsia is an important city on the caravan route from Kweihwacheng to Lanchow. It is also the distributing point for commerce with the Alashan Mongols and the banners of the western Ordos, but since both of these areas have a sparse population, the city has less contact with the desert than either Paotowchen or Kweihwacheng. The chief industry of the city,

both now as well as in the past, is the making of rugs. The rugs are used on the floors of the Mongol yurts, on the *kangs* of Chinese homes, and especially on the uncomfortable wooden saddles whose chief function seems to be as a foundation for layers of rugs and quilts. The saddle rugs, of a very fine wool, are justly prized throughout Mongolia (*72*).

FIG. 25. NINGSIA'S MAIN STREET

There are in reality two cities of Ningsia, the old or commercial city, with a population estimated at 85,000, and the new or military city some four miles to the west. The latter was built by the Manchus to house the several thousand Manchu soldiers who were stationed here prior to 1911, and is now deserted.

Santaoho

The settlement around Santaoho has been built up by the Belgian Catholic Fathers who have dug an irrigation ditch and established several colonies for their converts. This region is

surrounded by barren desert and the oasis is much smaller and less prosperous than any of those along the river farther south. A few trees have been planted by the Fathers, but cultivation is never very successful. The soil is sandy and poor, with patches of alkali. The rainfall is so low that much of the surface is almost devoid of vegetation. The entire population of the district numbers but a thousand families, and it is doubtful whether the community could sustain itself if outside assistance were withdrawn.

Wuyuan

The largest and least prosperous of the irrigated areas in the Ordos, lies between the present course of the Hwang Ho and its former bed at the foot of the Karanarin Ula. This district is known as Hotao, the region of the river, but may better be designated by the name of its principal town, Wuyuan (Fig. 26), since the term Hotao has sometimes been incorrectly applied to the entire Ordos. When Rockhill (*73*) travelled through the district in 1892, he painted a very dreary picture of the tangle of willow brush, reeds and spear grass, and spoke of the poverty and squalor of the inhabitants. Despite the developments of the past decade, the region is still poor and desolate. Historical records, however, refer vaguely to the former prosperity of Hotao. Most maps of China show an extensive system of canals or former river channels in this district. Most of them no longer carry water and the area now under cultivation is much smaller than at one time.

The Wuyuan region (*74*) has attracted considerable attention within recent years, and when General Feng Yu-hsiang occupied the northwestern provinces in 1925, he announced ambitious plans for reclamation and colonization. At the request of the Suiyuan Government, the China International Famine Relief Commission conducted an engineering survey of the old canals and laid out a program of excavation whereby as much as a million acres might be irrigated, an area over six times that which might be served by the canals now available. Unfortunately, political conditions stopped work in the early stages of the project and nothing further has been done.

The population of Wuyuan hsien in 1926 is estimated by the Post Office at 18,385. This number is augmented during the harvest season by several thousand coolies who come from Shansi, while during the winter many of the residents move to Paotowchen to escape depredations of bandits.

Aside from banditry and the distance from the railroad at Paotowchen, the chief problems of the Wuyuan area lie in securing water and in the character of the soil. Abundant water is available from the river and canals may be dug and maintained without

FIG. 26. IRRIGATION CANAL AT WUYAN
(Photograph from the China International Famine Relief Commission)

great difficulty, provided that there is proper supervision. The soil, however, tends to be infertile. Considerable areas are too sandy for cultivation and elsewhere the soil is impregnated with salt or alkali, even to the extent of showing a white efflorescence. In areas of excessive evaporation such as this, adding water by irrigation merely increases the possible amount of evaporation and so increases the concentration of these soluble materials in the upper horizons of the soil. The remedy for the situation lies either in expensive sub-drainage whereby the salts are flushed

out of the soil, or in growing certain salt consuming plants which may be cut and removed, so that in the course of several years the alkalinity of the soil is so reduced that normal cultivation is possible.

The data in table 2 were collected by the Suiyuan Industrial Board (*75*) and apply to 63 farm families in a small village near Linho in the Wuyuan area, and give a picture of the use and productivity of the land. Irrigation is almost essential, although

TABLE 2

Crop yields near Linho

PRODUCT	PERCENTAGE OF CULTIVATED LAND OCCUPIED	AVERAGE YIELD PER MOW	AVERAGE PRICE PER TAN	AVERAGE VALUE PER MOW
Millet	43.2%	5 tou	Mex. $3.00	Mex. $1.50
Wheat	35.3	4 tou	5.00	2.00
Peas	8.5	4.5 tou	6.00	2.70
Linseed	5.9	2 tou	6.00	1.20
Beans	4.0	4 tou	4.00	1.60
Buckwheat	1.1	3.5 tou	3.50	1.23
Potatoes	0.6	2,000 catties		
Kaoliang	0.3	5 tou	4.00	2.00
Melons	0.3			
Vegetables	0.3			
Others	0.4			
Total	100.0			

6 mow = 1 acre; 1 catty = 1⅓ pounds; 1 tou = about ¼ bushel; 10 tou = 1 tan.

a poor crop may be obtained from the better fields during the more favorable seasons.

Kweihwacheng

Around the city of Kweihwacheng, often merely called Kweihwa, is a broad plain which extends from the foot of the Taching Shan to the Hwang Ho (*76*). The best portion of the plain lies between Kweihwacheng and Saratsi, but lesser agricultural occupation extends to Paotowchen on the west and to longitude 112°

East on the east. Much of the area is too high to be irrigated from the Hwang Ho, but several small torrential streams flow out from the mountains and provide some water for nearby fields. The rainfall is more abundant than farther west and dry farming is possible with considerable success. The cultivated area amounts to something over a thousand square miles, although only a small portion is used intensively.

The Bureau of Economic Information (*77*) has studied conditions in an area of some 300 square miles to the west of Kweihwa thought to be representative of the better parts of the district. In this locality are 108 villages containing 10,247 families, with a total population of 54,577. The area under cultivation amounts to about 480,000 mow or nearly 80,000 acres, which is 40 per cent of the area. The population density is 182 per square mile, and the area of cultivated land per person is 8.8 mow, or nearly an acre and a half. The productivity of the land depends to a considerable extent upon irrigation. Where there are canals, the yield may be as much as twice that of fields dependent upon the rainfall alone. The price of well-irrigated fields near Saratsi is thus from five to six times that of non-irrigated fields, the former being worth over Mex. $40.00 per mow while the latter bring but $7.00 or $8.00 per mow.

Agricultural conditions have been studied in particular detail in the community of Pikechi, a village in the area described in the preceding paragraph. In this village dwell 1,101 families of whom 836 or 76 per cent are engaged in farming. Land holdings here are smaller than in most other districts for the average family, with nearly six people, has but 12.9 mow of land. Ninety-five per cent of the farms are smaller than 50 mow, and only three farmers cultivate more than 100 mow. Seventy per cent of the farmers own their own farms. A detailed survey of the crops of 73 farm families in the Pikechi district is given in table 3 (*78*).

Portions of the Kweihwacheng area have been occupied by the Chinese for several centuries, and the Tumet tribes who held the land before them had carried on some agriculture for a considerable period. With the construction of the Peiping Suiyuan Railroad which reached Paotowchen in 1923, a considerable number

of new colonists migrated to the region and settled in the lands to the south of the railroad. Unfortunately the railroad has been cut by military operations several times and has not been operating effectively as a freight carrier for half of its history, so that there has been no real opportunity to test the productive capacity of the region.

The fertile Kweihwa plain is one of the very few good agricultural areas not enclosed within the Great Wall and for centuries

TABLE 3

Crop yields near Pikechi

PRODUCT	PERCENTAGE OF CULTIVATED LAND	AVERAGE YIELD PER MOW	AVERAGE PRICE	AVERAGE VALUE PER MOW
Millet	35.7%	8 tou	$6.00 per tan	$4.80
Kaoliang	20.5	7 tou	6.00 per tan	4.20
Hemp	11.0	80 catties	17.00 per 100 catties	13.60
Wheat	7.0	7 tou	8.00 per tan	5.60
Green Peppers	4.4	20 catties	4.00 per 100 catties	0.80
Potatoes	4.3	2,000 catties	0.33 per 100 catties	6.60
Tobacco	3.4	100 catties	12.00 per 100 catties	12.00
Onions	3.0	900 catties	0.80 per 100 catties	7.20
Wild Oats	2.7	3.6 tou	6.60 per tan	2.37
Barley	2.0	8 tou	6.00 per tan	4.80
Vegetables	1.6	2,000 catties	0.50 per 100 catties	10.00
Buckwheat	1.4	5 tou	3.70 per tan	1.85
Garlic	1.3	400 catties	3.20 per 100 catties	12.80
Others	1.7			
Total	100.0			

has been a natural grain growing and supply area for the nomads of the desert (*79*). The present Chinese city, founded in 1573, has grown up around the numerous lama monasteries and is a strategic outpost for the aggressive business men of Shansi, to which province it formerly belonged. Nearby are the ruins of several cities whose history the archeologist has still to decipher. To the Mongols the city is known as Kuku Khoto or the blue town. There is a considerable Mohammedan population with three or four mosques. Like Ningsia, Kweihwacheng was one of the key

cities in the defense of the Manchu Empire, and some three miles away the Manchus built the military city of Suiyuan where formerly some 5000 Manchu bannerman were stationed. In this new city, the streets are wide and laid out in a rectangular pattern, whereas in Kweihwacheng they are commonly narrow and without plan. Suiyuan is now the political capital of the newly created province of the same name which embraces almost all of the Ordos.

FIG. 27. BAZAR IN TINGPIEN

Kweihwacheng is so situated as to command both the trade coming down the Hwang Ho and that from the Gobi, for just to the north of the city is the one pass through this section of the Taching Shan which is available for camel caravans. Many of the business houses were founded 300 years ago and have their agents in the remotest portions of Mongolia, Dzungaria, and Sinkiang. These firms either do business on their own account or undertake commissions for others. Some 7500 camels are re-

ported to be owned in Kweihwa, and each year hundreds of caravans arrive with wool, hides, furs, or cotton from the west. Bullock carts are also used, especially during the summer months when camels are not in their best condition. On their outward journeys, the caravans carry the varied objects which form the items of trade at the temple fairs and bazars in the oases of central Asia, such as small mirrors, needles, pocket books, snuff bottles, colored glasses, matches, cigarettes, incense, kerosene, millet and barley, and perchance flashlights and enamelled wash basins (Fig. 27).

The construction of the railroad has brought an increasing prosperity to Kweihwa for its market has been enlarged with the decreased transportation costs to the coast. The westward extension of the railroad to Paotow has already deprived Kweihwa of its strategic position at the head of steel, and when the line is some day continued to Sinkiang and other lines are built to Urga, Kweihwa will lose many of her widespread trade contacts and will be reduced to an unromantic local center. The population of Kweihwacheng and Suiyuan was estimated by foreign residents at 250,000 and 40,000, respectively, in 1924. The Post Office estimates for Kweihwa hsien in 1926, however, amounted to but 236,583.

Paotowchen

The thriving city of Paotowchen, sometimes known as Paotow, lies at the foot of the Taching Shan four miles north of the Hwang Ho and at the terminus of the Peiping Suiyuan Railroad. Until the completion of the railroad, Paotow was an unimportant market town under the administration of Saratsi hsien, but it is now growing rapidly and in 1924 had an estimated population of 150,000. Paotowchen forms an outpost of Chinese civilization, and is the gateway to the northwest. In contrast to the relatively unchanging cities in old China south of the Great Wall, it has an atmosphere which befits its pioneer situation. On account of its newness the commercial firms have less prestige than those of Kweihwa, and much of the trade handled here is on behalf of commercial houses located in Kweihwa.

According to a survey made by the Bureau of Economic Information (of the government at Peiping) in 1926 (*80*), there were 29 cereal dealers, 25 skin and wool exporters, and 28 grading firms which dealt with Mongolia and Sinkiang. The only modern industries are a flour mill and several small soap works. The principal old-style industries are rug works, of which there are 40, 30 tanneries, 50 skin curers, and 20 native flour mills. The annual export trade in animals and animal products is shown in table 4.

TABLE 4

Sheep wool	10,300,000 catties	= 13,700,000 pounds
Camel wool	5,000,000 catties	= 6,700,000 pounds
Goat hair	1,600,000 catties	= 2,100,000 pounds
Sheep skins	200,000 pieces	
Lamb skins	100,000 pieces	
Goat skins	50,000 pieces	
Cow hides	50,000 pieces	
Fox skins	10,000 pieces	
Sheep	90,000 animals	
Horses	10,000 animals	
Cattle	9,000 animals	

In addition to these items there is a large trade in millet, wheat and other cereals, some 200,000 piculs or more than 13,000 tons being exported annually in normal years. Wild licorice (*81*) is obtained in Kansu and the Ordos and passes out through Paotow. Salt and soda are found in many localities in the Ordos and Alashan Deserts and large quantities are brought to the railhead by boat or caravan.

Hwang Ho Navigation

The trade of Paotowchen (Fig. 28) is carried by camel and cart as from Kweihwa, and also by boat. The Hwang Ho is navigable for flat bottomed boats from above Chungwei to the falls at Hokou, and rafts of inflated pig skins or cow hides (Fig. 29) come down through the gorges from Lanchow. The boats are simple crafts from 30 to 40 feet long drawing not more than three and a half feet of water. Not infrequently they are sold for their timber after the down-stream trip. The boats are equipped with

crude sweeps made of split trees for occasional use in keeping away from the sand bars, but most of the time the boats merely float with the current. Small sails are used when the wind is favorable. During periods of high winds or in sections where the river spreads over a wide bed, the boats may become grounded and delayed for days.

The principal up-river shipping points for wool and hides are Chungwei, Ningsia, and Shihtsuitze, the latter being also the

FIG. 28. BAZAR AT PAOTOWCHEN

Camel pullers from Turkestan barter animals or wool for the cloth, brick tea and rugs of merchants from Tientsin.

chief concentration center for salt and soda. The Bureau of Economic Information, apparently taking its information from De Lesdain, estimates the number of boats on this section of the river at 5000, but the writer would place the number at less than 1000. Doubtless the number varies greatly with the general prosperity of the district. The trip from Ningsia to Paotow may be made in a week under favorable conditions, but the time

is usually somewhat longer. On a journey by the writer in the late summer of 1924, the actual time en route each day, including many hours of trouble with and bars, amounted to a total of 136 hours. Unfavorable winds and difficulties with bandits, however, caused the trip to require 20 days. On the up-stream journey, the boats are pulled by trackers walking along the bank or wading through shallow water, or are pushed by long poles thrust into the bed of the river. At times, the boats are rowed by crude

FIG. 29. OXHIDE RAFTS ON THE HWANG HO AT PAOTOWCHEN
(Photograph from the China International Famine Relief Commission)

oars (Fig. 30). The journey from Paotow to Ningsia or Chungwei requires from a month to a month and a half. Since the river is free from ice for but eight months in the year, these boats can make only a few round trips each season. Little cargo is carried by the boats on their up-river trips as the overland journey by carts requires but half the time. A few attempts have been made to use steam craft but they have ended in complete failure on account of the shallowness of the river. The writer believes that outboard motors might be used to advantage, especially for a mail and passenger service.

An ancient cart road leads westward from Paotow around the outside of the river, and in 1926 an automobile service was inaugurated over an auto road built under military supervision, the trip from Paotowchen to Ningsia being made in three days. Unfortunately, the service was suspended after a few months. The success of this or any other form of improved transportation must await the reëstablishment of peace, for at present the region is infested with bandits.

FIG. 30. HWANG HO BOATS AT TENGKOW
The mast is used more for a tow-line than for a sail

Saratsi

South of Saratsi a large irrigation project has been constructed under the auspices of the China International Famine Relief Commission and the Suiyuan provincial government which will utilize the water of the Hwang Ho to irrigate 2,000,000 mow, or about 335,000 acres. Work was started in 1929 and completed in 1931. This project is under the engineering direction of O. J. Todd (*82*), Chief engineer of the Relief Commission. The main

canal, 40 miles long, has a bottom width of 60 feet at the intake (Fig. 31), decreasing to 45 feet in the east, while the 14 laterals are 10 feet wide at the base. The depth of the canals varies from 10 to 7 feet. The canals have been dug by hand at a cost of U. S. $0.02 per cubic yard, from 1000 to 5000 laborers being employed according to the season. The entire project, including a submerged weir across the Hwang Ho, was estimated to cost Mex. $800,000, a considerable part of which was furnished from American relief funds on a loan basis. It is of interest to note

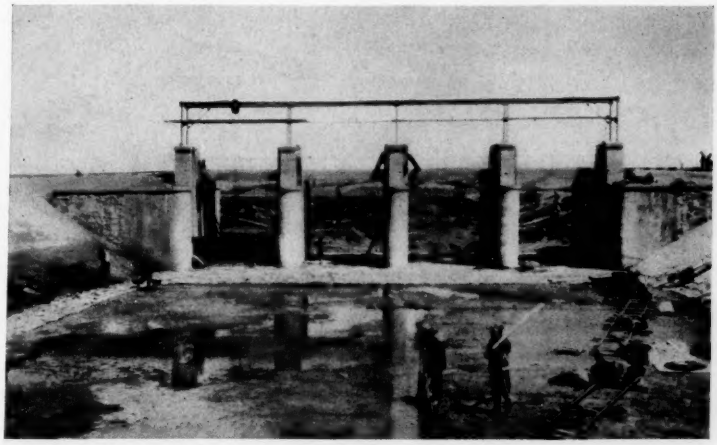

FIG. 31. MAIN HEADGATE AT INTAKE FOR SARATSI IRRIGATION PROJECT
(Photograph from O. J. Todd)

that the various bridges over the canals were constructed of Oregon pine. The project should materially add to the prosperity of the district and should make famine from drought unlikely (Fig. 32). The real problem in this and similar situations, however, is to keep the population from expanding up to the new productive capacity of the land. It is surely of no value to quadruple the amount of food produced if the number of mouths to be fed is increased in the same proportion.

Irrigation projects similar to that at Saratsi are probably

feasible at several other points along the Hwang Ho in its course through the Ordos. Reference has already been made to surveys by the China International Famine Relief Commission in the Wuyuan area. Engineering advice could also materially extend the irrigated areas in those districts, such as Ningsia, where canals already are in use. It is even conceivable that parts of the Ordos might be transformed in a manner similar to the reclama-

FIG. 32. SAND DUNES INVADING CULTIVATED FIELDS NEAR THE GREAT WALL BETWEEN YULIN AND SHENMU

(Photograph from F. M. Exner)

tion of the Indus Valley in northwestern India. Such a condition, if ever to be attained, must await a stable and rich government and improved transportation.

Eastern Ordos

In the eastern Ordos is still another region of Chinese colonization along the line of the Great Wall. The agricultural population is everywhere sparse, and thins out toward the west. The

German explorer Tafel (*83*) travelled from Paotowchen south to Yulin in 1908, and reported Chinese farmers scattered all along his route, although the cultivated land amounted to only a small portion of the area. The best agricultural sections are in the extreme south of the Ordos north of Chingpien, in the north opposite Paotowchen, and in the east near the Hwang Ho. In some of these areas the Mongols have settled down to a sedentary life after the Chinese manner and have combined farming with stock raising.

The entire Mongolian borderland is an area of precarious agriculture. Irrigation can modify but one of the unfavorable factors of the environment, and on un-irrigated fields harvests are conditioned upon favorable precipitation. Except for the districts along the Hwang Ho, the agricultural possibilities of the region are rigorously limited. At the utmost it seems unlikely that the Ordos can ever absorb an additional population of more than two or three million, which is but a small fraction of China's surplus. No other part of southern Mongolia has possibilities of irrigation similar to those in the Ordos and any agricultural expansion in the lands to the north of the Great Wall must come through dry farming. The roseate hopes often held out of Mongolia's being able to absorb the surplus millions of old China are without foundation. So long as the physical environment remains as at present, the Ordos is not a safe land for the farmer.

Appendix A

The map of the Ordos (plate II)

The map of the Ordos and vicinity, which accompanies this article, represents one of the principal contributions of this study. Previous maps have contained large errors, in cases amounting to nearly a degree of longitude, and considerable uncertainty still exists as to the exact position of the Great Wall and the Hwang Ho. This map is based upon the most authoritative material, checked by the field notes of the writer, and is thought to be the best map available for this part of Mongolia. The following source material was used in the drafting of the map. The order is chronological.

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Appendix B

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Sincere thanks are tendered the Board of Trustees of Denison University for their wisdom and foresight in continuing an appropriation to THE JOURNAL, thus enabling us to issue our publication in spite of the severe financial conditions that still obtain.

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